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An Ordering of the NIOSH Suspected Carcinogens List Based on Production and Use Data

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An Ordering of the NIOSH Suspected Carcinogens List Based on Production and Use Data

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Office of Toxic Substances
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Project Officer

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16. ABSTRACT
Building on an earlier EPA report entitled "On Ordering of the NIOSH Suspected Carcinogens List Based Only on Data Contained in the List" (EPA 560/1-76-001), the present document represents the second OTS effort to arrange the substances presented in the NIOSH Suspected Carcinogens Subfile in a meaningful and useful way for EPA purposes. Employing readily available information on the uses and commercial significance of the chemicals listed in the NIOSH Subfile, OTS has further refined the initial ordering into the four tables contained in this report.

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This report has been reviewed by the Office of Toxic Substances, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

PREFACE

The National Institute of Occupational Safety and Health (NIOSH) annually publishes the Registry of Toxic Effects of Chemical Substances (RTECS), formerly called the Toxic Substances List. In 1975, NIOSH published a subfile of the RTECS, Suspected Carcinogens, A Subfile of the NIOSH Toxic Substances List, which lists chemicals reported in the literature as having caused benign or malignant tumors in at least one species. The obvious concern over this list of chemicals and the fact that some might fall within the Environmental Protection Agency's (EPA's) regulatory jurisdiction by virtue of their use patterns led the EPA Office of Toxic Substances (OTS) to undertake an effort to identify those substances in the Subfile deserving OTS attention. Initially, the NIOSH Subfile was reordered according to cited carcinogenicity data. That ordering[1] (summarized in the Appendix) suggests the degree of concern that might be warranted regarding the carcinogenic potential of the listed chemicals.

Employing readily available information on uses and commercial significance, OTS has further refined the initial ordering into the four tables contained in this report. Table 1 lists chemicals that might need delineation of their environmental hazard potential--particularly their carcinogenic threat. The chemicals contained in Tables 2 and 3 are considered less significant at this time because they either fall more appropriately under another agency's regulatory authority (Table 2) or because (Table 3) insufficient information was developed to warrant the inclusion of the entries in another table. It should be recognized, however, that some chemicals in Tables 2 and 3 may become environmentally important in the future as their uses change. Table 4 is a composite of the first three tables, presenting production and use information on those substances

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[1] An Ordering of the NIOSH Suspected Carcinogens List Based Only on Data Contained in the List, available through the National Technical Information Service, Springfield, VA 22151, as NTIS publication PB-251-851.

investigated by other than environmentally significant routes of administration which, nonetheless, produced tumors at sites remote from the point of introduction. Some of the entries in Table 4 might require additional definition as was suggested for Table 1 chemicals.

The tables in this report share limitations with the NIOSH Subfile data. In particular, a substance's inclusion in the NIOSH Subfile is based on the conclusions of the author(s) of the study cited that the investigated substance produced a neoplastic or carcinogenic response. In many cases the only data evaluation in evidence is that provided by the scientific community prior to publication in private literature. Neither NIOSH nor OTS has attempted to resolve questionable published data or to evaluate an author's interpretation. It is not appropriate to conclude that all substances listed in this report are carcinogenic or of regulatory interest to EPA.

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I. APPROACH

After the initial ordering of an updated version[1] of the 1975 NIOSH Suspected Carcinogens Subfile in March 1976, EPA made refinements to provide a better definition of the environmental exposure for each substance on the list. Efforts were made to ascertain the commercial significance of the chemicals. This was done primarily by using information readily available in the secondary sources referenced herein; however, examination of the primary literature was also necessary in a few cases. The basic factors examined were production levels (when available) and commercial applications. Chemicals that have received in-depth carcinogenicity evaluations by the International Agency for Research on Cancer (IARC) were also identified.

An understanding of the approach used to develop this list is facilitated by referring to Figure 1, a flow diagram presenting a schematic of the entire process. Starting from point A, a combination of machine and manual techniques was used to reduce and define the list of 1,693 compounds contained in the initial EPA-ordered NIOSH Subfile of Suspected Carcinogens. First, the availability of a Chemical Abstracts Services (CAS) registry number was determined for each compound. This determination was important because only those chemicals possessing a CAS number would be eligible for the subsequent automated search; of the 1,693 compounds in the NIOSH Subfile, only 928 had CAS numbers. The machine manipulation (B) consisted of a comparison between the CAS-numbered NIOSH Subfile entries and those chemicals contained on the Stanford Research Institute's (SRI) file of 26,755 commercially significant (COMSIG) chemicals. The intersection of the two lists produced matches of 632 compounds.

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[1] NIOSH made this updated version of the published subfile available to OTS on computer tape.

For the 765 substances having no CAS number, a manual search of the TSCA Candidate List of Chemical Substances (April 1977) and other information sources was conducted to determine the commercially significant chemicals (step C). This search soon indicated that the overwhelming majority of these compounds have little, if any, commercial significance. Generally, they are laboratory research materials (e.g., experimental carcinogens), analytical reagents, and members of certain structural classes known to have a proclivity to induce carcinogenesis. Some substances in this latter group appear to have been synthesized at the laboratory level to test a wider variety of substances in a given structural class. Conceivably, certain compounds in this category could have some environmental significance; examples are polynuclear aromatics and N-nitroso compounds. Only 5 of the 765 compounds without CAS numbers were found to have some commercial significance; these were added to the list obtained from the COMSIG intersection to yield a total of 637 chemicals.

Step D involved examination of the route of exposure (e.g., inhalation vs. oral vs. injection, etc.) recorded for each chemical as represented by the third digit of the OTS 4-digit ranking code. In general, an oncogenic response to level 1 (oral) or level 2 (inhalation, dermal, or ocular) exposure was considered more environmentally significant than responses following level 0 (injection, implant, etc.) exposure. Accordingly, level 1 and level 2 chemicals were combined and considered separately from level 0 compounds. All of the chemicals from levels 1 and 2 (total of 383) were designated as "hits" in the present work and would ultimately appear in one of the tables. Level 0 compounds (total of 254), on the other hand, were subjected to an additional refining step involving a determination of level 0 compounds which reported the development of tumors at sites remote from the point of administration. Evidence of this nature was considered more indicative of a chemical's possible environmental significance than

reports that the chemical produced local tumors only. While flaws were evident in this approach, it was felt that such a distinction was better than inclusion of either all or none of the level 0 chemicals. Accordingly, the primary literature was examined (step E) and the studies (i.e., compounds) were separated into two groups: those reporting local tumors only (151 entries) and those having evidence of remote tumor development (103 entries). The "local tumors only" chemicals were given no further consideration, while the "evidence of remote tumors" group would ultimately appear in various parts of Table 4.

All "hit" chemicals (basically level 1 and level 2 compounds plus the "remote tumors" subset of the level 0 chemicals) were then subjected to essentially the same examination process. Nonprime letters (e.g., F) indicate level 1 and level 2 chemicals, while letters prime (e.g. G') refer to the subset of level 0 chemicals.

The first common step (F and F') was an intensive examination of (predominantly) secondary sources of production and use information. A listing of the publications consulted can be found in the "References" section. Only very limited information was available for a number of the "hit" chemicals; these were assigned to Table 3 (G; 147 entries) or Table 4C (G'; 12 entries) and were listed according to their OTS 4-digit rank designation.[2] Compounds with identical OTS rank numbers were listed alphanumerically by NIOSH sort key within each group. While many of the substances in these two tables appe. to be of limited commercial significance (interpreting the paucity of production and use information as somewhat indicative of minimal industrial significance), caution is advised

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[2] OTS rank number -- a higher number indicates greater evidence of carcinogenic potential (see Appendix).

because inclusion in these tables does not reflect a definitive judgment.

The remaining chemicals were grouped on the basis of their reported uses. Chemicals of primary interest to the Food and Drug Administration or EPA's Office of Pesticides Programs were separated as follows (refer to Figures 1 and 2, pp. 7 and 8):

(a) food-cosmetics related chemicals: Table 2A (H; 4 entries) and Table 4B-1 (H'; 2 entries).

(b) pharmaceuticals: Table 2B (I; 40 entries) and Table 4B-2 (I'; 31 entries).

(c) pesticides in Table 1B (J; 36 entries) and Table 4A-2 (J'; 14 entries).

As before, all chemicals were ordered on the basis of their OTS rank code with the NIOSH sort key used as a second-level sorting parameter.

The remaining chemicals (a total of 200) represent a core group of substances from the NIOSH Subfile having the greatest potential interest to the EPA Office of Toxic Substances. Most are industrial chemicals produced in amounts ranging from less than 1,000 pounds to several billion pounds per year. Because of the wide range in reported production volumes for these chemicals, a dual-level sorting hierarchy was employed to order the entries. Production level was considered first (highest to lowest), followed by the OTS 4-digit rank number. (As before, entries having identical rankings were ultimately ordered alphanumerically by the NIOSH sort key.)

Accordingly, the order in which chemicals are listed in Table 1A (K; 156 entries) and Table 4A-1 (K'; 44 entries) indicates the relative significance of these chemicals with regard to their potential for environmental exposure (and thus their hazard potential). Of the 156 compounds in Table 1A, at least 60 are clearly of commercial significance. Another 51 chemicals are reportedly produced in quantities greater than 1,000 pounds per year. The remaining 45 chemicals

are currently produced in quantities less than 1,000 pounds per year; however, the information is sketchy and the chemicals may be of commercial importance in the future, or might have been within the past few years. Seventy-eight substances in Table 1A have been evaluated by the IARC in its monographs.[3] Seven are indicated to be human positive carcinogens; 4, human suspected; 42, animal positive; 6, animal suspected; 17, indefinite; and 2, negative.

Table 4A-1 contains 44 chemicals, 19 of which are of documented commercial importance. Sixteen others are produced at levels in excess of 1,000 pounds per year, while the 9 remaining chemicals are produced at levels less than 1,000 pounds or their commercial importance in the recent past or future is uncertain. Twenty chemicals in Table 4A-1 have been evaluated by the IARC. Of these, none are human positive carcinogens; 3, human suspected; 9, animal positive; 3, animal suspected; and 5, indefinite.

As a result of this exercise and other factors, preparation of hazard assessment documents has started or is planned for such chemicals as epichlorohydrin, ethylene glycol, and others. In addition, for selected unevaluated chemicals (e.g., no IARC review) that are commercially significant, an in-depth evaluation of carcinogenicity and other toxicity data will be performed by recognized experts under extramural contract. Present plans call for the preparation of periodic updates to this list as additional suspected carcinogens are identified by NIOSH. However, no time frame has currently been established for this work.

Each of the four tables has seven columns. Column one identifies each substance by its unique CAS number. (Only a few compounds in these tables do not have CAS numbers. The CAS numbers used in these tables have been taken

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[3] IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.

predominantly from the TSCA Candidate List of Chemical Substances [April 1977]; in cases where the substance was not contained in the Candidate List, either the NIOSH Subfile-listed CAS number or the CHEMNAME data base-reported number was used.) Column two gives the OTS rank number assigned to the chemical in the original EPA-ordered version. Column three lists the alphanumeric sequence designation used in the NIOSH Registry of Toxic Effects of Chemical Substances, which allows easy location of the main entry. Column four indicates the approximate annual production level of a compound, from I representing 1,000 pounds to V representing 1 billion pounds. The latest available annual production figures are used. Column five gives a common chemical or trade name for each substance. Column six indicates whether an evaluation of carcinogenicity data has been conducted by the IARC in its monograph reviews; it also contains a symbol representing the review conclusion at the time of preparation, ranging from HP for human positive to AS for animal suspected, and ID for indefinite. The last column lists the uses of the substance, as found in the various secondary references consulted.

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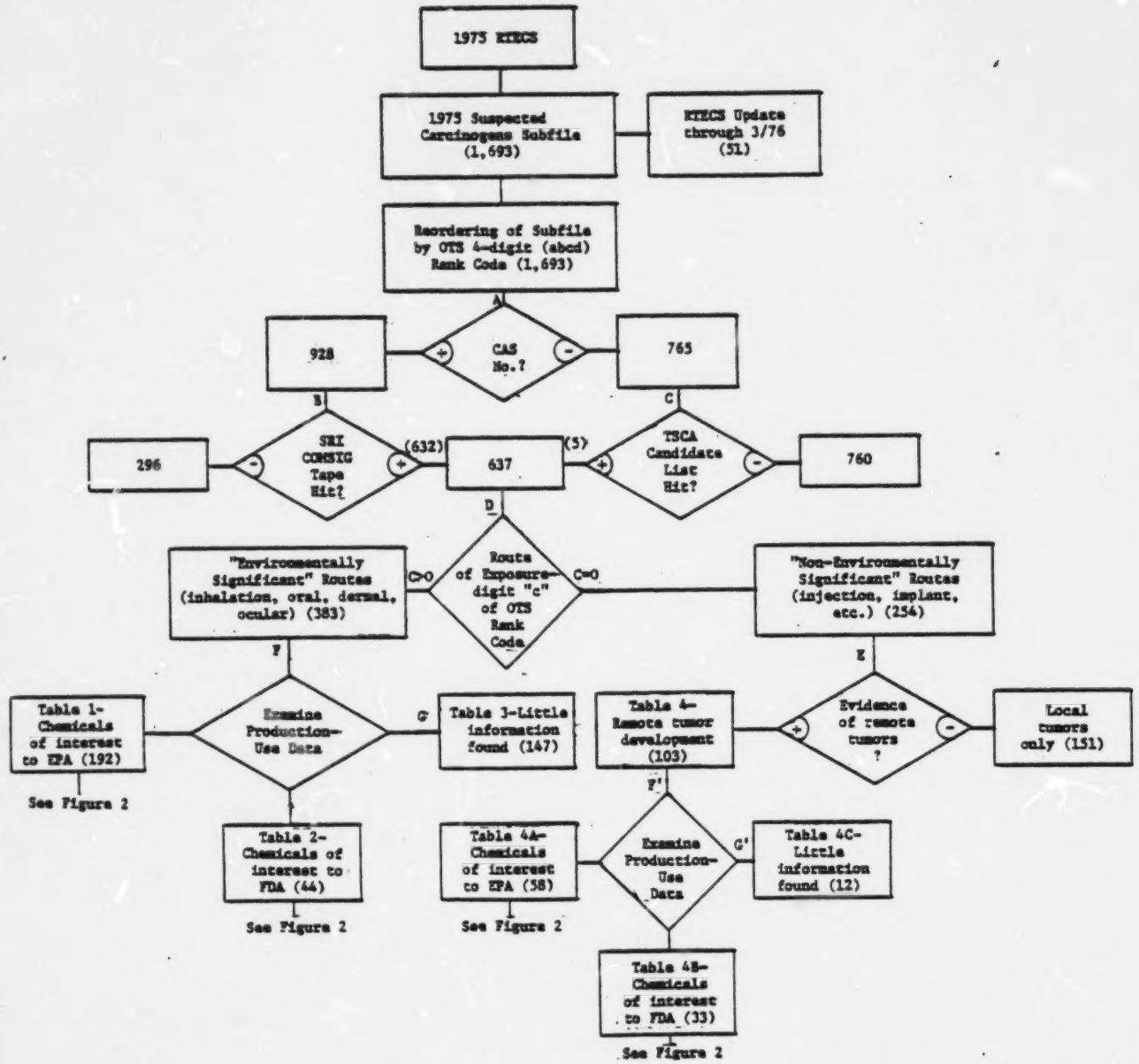

FIGURE 1. Flow diagram of the approach followed in this project. (Figures in parentheses represent the number of chemicals involved at each point in the process.)

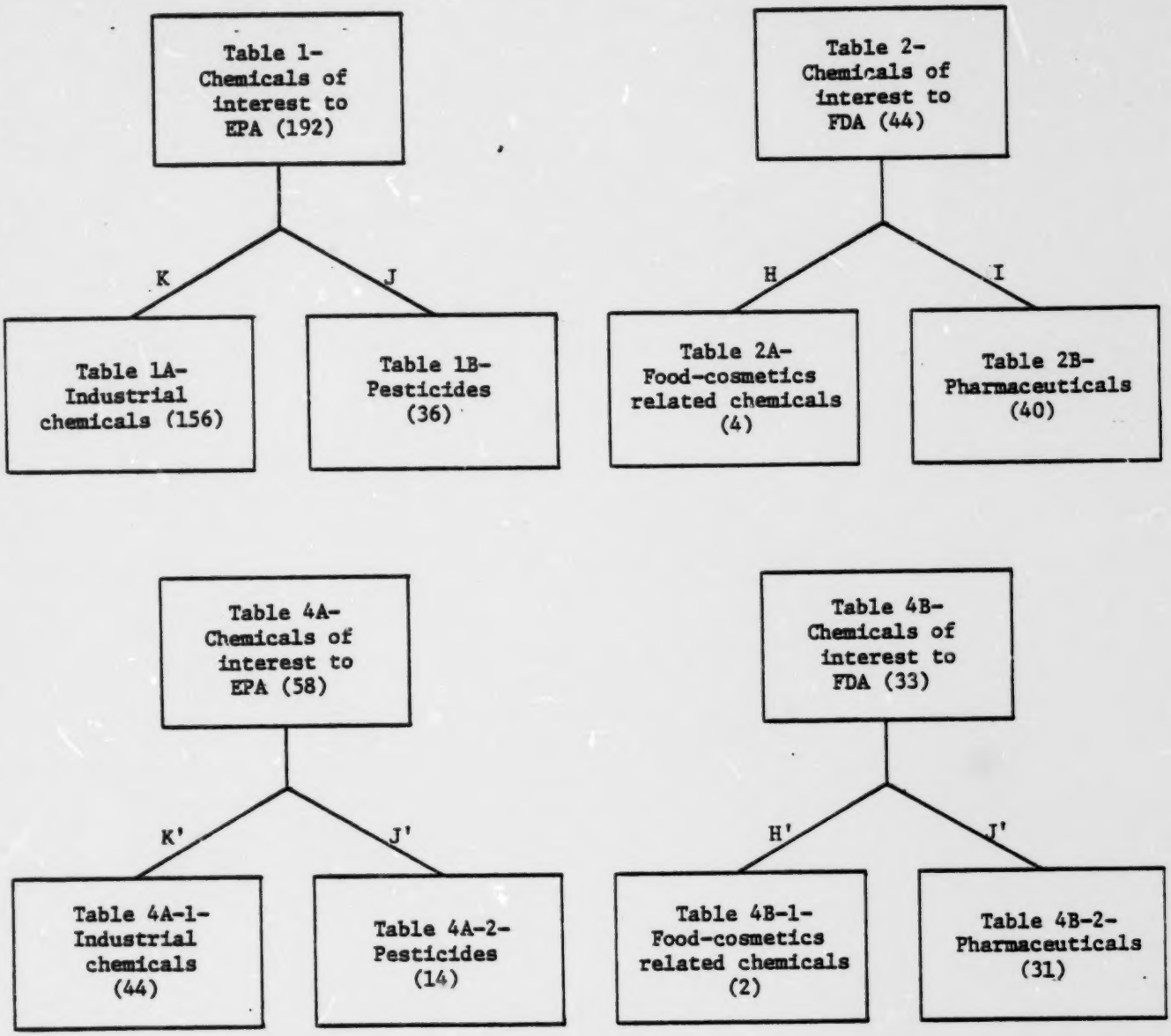

FIGURE 2. Continuation of the flow diagram presented in Figure 1.

TABLE 1. CHEMICALS FROM THE NIOSH SUBFILE OF SUSPECTED CARCINOGENS (1975) WHICH HAVE COMMERCIAL SIGNIFICANCE AND MAY HAVE ENVIRONMENTAL SIGNIFICANCE

A) Commercially Significant (annual production in excess of 1000 lb)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000056235	4313	FG49000	V ($>10^9$ lb)	carbon tetrachloride	AP	Production of fluorocarbon refrigerants and propellants; degreasing; agricultural fumigant; chlorinating organic compounds; fire extinguisher; dry cleaning of clothing
001332214	4123	CI64750	V	asbestos	HP	Brake linings; fireproof fabrics; roofing composition; insulation; filters; paint filler; rubber and plastic reinforcer; diaphragm cells
000084651	4111	CB47250	V (dyes)	anthraquinone		Starting material to produce dyes and organics; bird repellant for seeds; organic inhibitor
000071432	3121 (7222)	CY14000	V	benzene	HS	Manufacture of organic chemical intermediates for styrene monomer, detergents, nylon, aniline, antiknock gasoline; artificial leathers, dyes; solvent (printing inks)
+000107211	3121	KW29750	V	ethylene glycol		Antifreeze; hydraulic brake fluids; in electrolytic condensers; in printers' inks; in ballpoint pen inks
000108952	3121	SJ33250	V	phenol		Phenolic resins; organic compounds; germicidal paints; pharmaceuticals; dyes and indicators; epoxy resins; disinfectant; reagent; antiseptic
007440020	4429	QR59500	IV ($>10^7$ lb)	nickel	AS	Plating; alloys; coins; batteries; magnets; electrodes; spark plugs; catalyst for hydrogenating oils and methanating fuel gases; ceramics
000075014	4222 (7323)	KU96250	IV	vinyl chloride	HP	Polyvinyl chloride and copolymer resins; plastic adhesive; organic synthesis; wire and cable coverings; shoe soles; raincoats; textile finishes
000095807	4112 (4111)	XS96250	IV	toluene-2,4-diamine; CI 76035		To produce toluene diisocyanate; dye intermediate; direct oxidation black for furs and hair

Footnotes: see pp. 23 and 24.

TABLE 1. (SECTION A continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000123911	4111 (4323)	JG82250	IV	dioxane	AP	Organic solvent
000106898	3122 (3101)	TX49000	IV	epichlorohydrin	AP	To make synthetic glycerins; epoxy resins; solvent for gums, paints, lacquers, nail enamels, and cellulose esters and ethers; cement for Celluloid; curing propylene-based rubbers
000096480	3121	LU35000	IV	4-butyrolactone; hydroxybutyric acid lactone	ID	Chemical intermediate in production of 2-pyrrolidone; solvent for many polymers and petroleum products
007803578	3121	MV80500	IV[e]	hydrazine hydrate		Reducing agent; oxygen scavenger in boiler water treatment; chemical intermediate
000123319	3121	MX35000	IV	hydroquinone[f]		Photographic developer; stabilizer in paints, varnishes, motor fuels, and oils; antioxidant; polymerization inhibitor; dye intermediate; medicine
050825291	3121	OG20250	IV	lead naphthenate		Paint and varnish drier; wood preservative; insecticide; catalyst; additive in lube oil and metallic soaps
000067663	3111 (4212)	FS91000	IV	chloroform	AS	Production of fluorocarbon refrigerants and propellants; fluorocarbon plastics; fumigant; insecticide; solvent; in fire extinguishers; in rubber industry
000079016	3111	KX45500	IV	trichloroethylene	AS	Solvent; degreasing; dry cleaning; manufacture of organic chemicals and pharmaceuticals; fumigant; textile processing; refrigerant
000091941	5416	DD05250	III ($>10^6$ lb)	3,3'-dichlorobenzidine (base and salts)	AP(C)	Intermediate for azo dyes and pigments; curing agent in isocyanate-terminated resins for urethan plastics
000137304	4213	ZH05250	III	ziram; zinc dimethyl dithiocarbamate	ID	Fungicide; rubber vulcanization accelerator
000151564	4212	KX50750	III	ethyleneimine; aziridine	AP(C)	Polymerized into polyethyleneimine; to produce 2-aziridinyl; intermediate and monomer for oil additives, ion exchange resins, coating resins, pharmaceuticals, adhesives, surfactants, and polymer stabilizers

Footnotes: see pp. 23 and 24.

TABLE 1. (SECTION A continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
001302529	4121	DS14000	III	beryl	AP	Natural silicate for producing beryllium; synthetic emeralds
000101779	4112	BY54250	III	4,4'-methylenedianiline		Manufacture of polymethylene polyphenylisocyanate, 4,4'-methylenediphenyl isocyanate, 4,4'-methylenebis(cyclohexylamine), and poly(amide-imide) resins and fibers; dye intermediate; corrosion inhibitor; analytical reagent
000101144	4112	CY10500	III	MOCA[R]	AP(C)	Curing agent for elastomers, epoxy resins, and rubbers
000915673	4111	QJ65500	III	amaranth; Red Dye No. 2; CI 16185	ID	Dyeing wool and cotton; in color photography; as an indicator in hydrazine titrations
000062566	4111	YU28000	III[E]	thiourea	AP	In photosensitive papers; production of flame-retardant textile sizes; boiler water treatment; photographic chemicals; vulcanization accelerator; in silver-cleaning compounds; in glues
000105748	3123 (3122)	OF26250	III (consumption estimate)	lauroyl peroxide		Bleaching agent, intermediate, and drying agent for fats, oils, and waxes; polymerization catalyst
000094360	3121	DM85750	III	benzoyl peroxide		Bleaching agent for flour, fats, oils, and waxes; polymerization catalyst; drying agent for unsaturated oils; production of pharmaceuticals and cosmetics; rubber volcanization without sulfur
000110054	3121	ER24500	III	di-t-butyl peroxide; bis(1,1-dimethylethyl) peroxide		Polymerization initiator; organic synthesis; ignition accelerator for diesel fuels
000086306	3112	JJ98000	III	N-nitrosodiphenylamine		Rubber vulcanization retarder; pesticide
000135886	3112	QM45500	III	Neozone D[R]; 2-phenylaminonaphthalene		Rubber antioxidant
000136232	3111	ZH01750	III	Butyl Zimate[R]; zinc dibutyldithiocarbamate		Accelerator for latex dispersions, cements, neoprene latexes, etc.; ultra-accelerator for lubricating oil additives

Footnotes: see pp. 23 and 24.

TABLE I. (SECTION A continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000097563	4315 (5416)	XU88000	II ($>10^5$ lb)	CI Solvent Yellow 3; CI 11160B	AP	Manufacture of dyes and medicine
000680788	4111	BQ43750	II	Guinea Green B; CI 42085		Dye for silk and wool fabrics
002611827	4111	QJ65300	II	Ponceau 4R; Food Red 7; CI 16255		Dye
004548532	4111	QK27050	II	Ponceau SX; FD&C Red No. 4; CI 16045	(H)	Colorant for cosmetics and soaps; (formerly in maraschino cherries)
000614459	3121	SD94500	II	t-butyl perbenzoate		Polymerization initiator for polyethylene, polystyrene, polyacrylates, and polyesters; chemical intermediate
000627123	3112	FD08750	II	propyl carbamate	AP	Organic intermediate for resins; as a durable-press fabric finisher for cotton and cotton/polyester blends
000842079	3112 (3101)	QL49000	II	Sudan I[R]; CI 12055	AP	To color fats, oils, and waxes; biological stain
000111444	3111	KN08750	II	bis(2-chloroethyl) ether	AP	Solvent for fats, waxes, greases, and cellulose esters; scouring agent for textiles; paints, varnishes and lacquers; dry cleaning; soil fumigant; chemical intermediate; wetting compounds
000057147	3111	HV24500	II	1,1-dimethylhydrazine; Dimazine[R]; UDMH	AP	Storable high-energy rocket fuel; synthesis of plant growth regulators; chemical intermediate
000532821	3111	ST33800	II	chrysoidine; CI 11270	AP	Dye for silk and cotton; colorant in textiles, paper, leather, inks, and wool; biological stain
000092875	7426	DC96250	I ($>10^3$ lb)	benzidine	HP(C)	Organic synthesis; biological stain; stiffening agent in rubber compounding; manufacture dyes; analytical reagent
000050328	6629	DJ36750	I	benzo(a)pyrene	AP	Cancer research; occurs in coal tars, cigarette smoke, and the atmosphere as a product of incomplete combustion

Footnotes: see pp. 23 and 24.

TABLE I. (SECTION A Continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
007787566	6222	DS50000	I	beryllium sulfate tetrahydrate	AP	In refining beryllium
000684935	5529	YT78750	I	nitrosomethylurea; NMU	AP	Widely used in laboratories to synthesize diazomethane; chemotherapeutic
001304569	5324 (5325)	DS40250	I	beryllium oxide	AP	In nuclear reactor fuels and moderators; electron tubes; transistor mountings; additive to glass and ceramics; catalyst for organic reactions
000051796	4429	FA84000	I	urethan(e)[h]; ethyl carbamate	AP	Organic solvent; biochemical research; intermediate for pharmaceuticals, pesticides, and fungicides
000094597	4212	CY28000	I (perhaps II)	safrole	AP	Perfume; to denature fats in soap manufacturing; topical antiseptic; pediculicide; carminative
000119904	4212	DD08750	I (likely II)	3,3'-dimethoxybenzidine; CI 24110	AP	Manufacture of azo dyes and pigments; dyeing of cotton
000077781	4122	WS82250	I	dimethyl sulfate	HS	Methylating agent for organic chemicals
007787497	4121	DS28000	I	beryllium fluoride		To produce beryllium metal, alloys, and glass; in nuclear reactors
000119937	4113	DD12250	I[i]	3,3'-dimethyl-benzidine; CI 37230	AP	Manufacture of dyes; analytical reagent to detect acid and chlorine in water
000064675	4112 (4113)	WS78750	I	diethyl sulfate	AP	Ethylating agent; accelerator in sulfation of ethylene; some sulfonations
000135206	4111	NC47250	I	cupferron		Separation of copper and iron from metals; quantitative reagent for detecting titanium, vanadates, and aluminum
003761533	4111	QJ68250	I	Ponceau MX; CI 16150	AP	Textile and leather dye; colorant for paper, inks, and wood stains; (84,000 lb in 1975)
000057396	4111	SZ19250	I	metepa	AS	Insect chemosterilant; crease- and flame-proofing of textiles; intermediate; cross-linking agent

Footnotes: see pp. 23 and 24.

TABLE I. (SECTION A continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
0000107302	3223 (4323)	KN66500	I	chloromethyl methyl ether	HS(C)	Intermediate in organic synthesis; in ion-exchange resins
000096093	3122 (3121)	CZ96250	I	styrene oxide	ID	Highly reactive organic intermediate; reactive diluent, in epoxy resins
000110225	3121	AP85000	I	acetyl peroxide		Initiator and catalyst for resins
000598550	3121	FC24500	I (likely II)	methyl carbamate	ID	Insecticide; durable-press fabric finish for polyester/cotton blends
000109842	3111	KL28000	I	2-hydrazinoethanol		Analytical reagent; plant growth regulator
001333820	7222	GB66500	(I)	chromium (VI) oxide	ID	Chemicals (catalysts, oxidizers, chromates); plating; engraving; anodizing; tanning; metal cleaning; medicine; inks; paints; ceramic glazes; textile mordant; colored glass
000091598	6517	QM21000	(I)	2-naphthylamine; CI 37270	HP(C)	Formerly an intermediate in manufacture of dyes and antioxidants but replaced by a corresponding compound
000056531	4416 (4418)	WJ56000	(I)	DES; diethylstilbestrol	HP	Animal growth hormone; emergency contraceptive; biochemical research
000060117	4324 (5425)	BX73500	(I)	DAB; p-(dimethyl-amino)azobenzene; CI 11020	AP(C)	To color polishes and other wax products; analytical reagent to identify peroxidized fats, pH, and free hydrochloric acid
010034932	4213	MV96250	(I)	hydrazine sulfate		Refining rare metals; in fungicides; antioxidant; analytical reagent to determine cobalt, cadmium, and nickel; in hematology tests
000062555	4212	AC89250	(I)	thioacetamide	AP	Substitute for hydrogen sulfide in analytical chemistry
000096457	4212	NI96250	(I)	ethylene thiourea	AP	Accelerator in compounding and curing rubber
001335326	4212	OF87500	(I)	lead subacetate	AP	To clarify and decolorize organic matter in solution; in sugar analysis as a decolorizer

Footnotes: see pp. 23 and 24.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000075707	4121	PB52500	(I)	perchloromethyl mercaptan		Organic synthesis; dye intermediate; fumigant
000680319	4121	TD08750	(I)	HMPA; hempa; hexamethylphosphoramide		Specialty solvent in organic synthesis; patent for deicing additive for jet fuels; experimental chemosterilant for insects; UV-inhibitor in polyvinyl chloride
002465272	4112 (4213)	BY36750	(I)	auramine O; CI 41000		Dye for paper, textiles, and leather; antiseptic; fungicide; biological stain
000531862	4112	DD15750	(I)	benzidine sulfate	(C)	Organic synthesis; (ITC-listed)
000080488	4112	XT70000	(I)	methyl-p-toluenesulfonate		Accelerator; methylating agent; catalyst for alkyd resins
000108770	4112	XZ14000	(I)	cyanuric chloride		Chemical synthesis; dyestuffs; pharmaceuticals; explosives; surfactants; herbicides; optical brighteners
000108805	4112	XZ18000	(I)	cyanuric acid		Herbicide; laboratory source for cyanic acid gas; intermediate for chlorinated bleaches; whitening agents
000060355	4111	AB40250	(I)	acetamide	AP	Solvent for organic and inorganic compounds; plasticizer; stabilizer
000301042	4111	AI52500	(I)	lead acetate	ID[j]	Dyeing and printing cottons; astringent; manufacture of lead salts and colors
000139651	4111	BY96250	(I)	4,4'-thioaniline; 4,4'-thiobis(benzenamine)		Dye intermediate; formerly an antimalarial drug
000118923	4111	CB24500	(I)	anthranilic acid; o-aminobenzoic acid		Manufacture of dyes; synthesis of perfumes and pharmaceuticals
020325400	4111	DD10500	(I)	o-dianisidine dihydrochloride; 3,3'-dimethoxybenzidine dihydrochloride		Manufacture of dyes; to produce dianisidine diisocyanate (used in adhesive systems and polymers)
001528741	4111	DV40000	(I)	4,4'-dinitrobiphenyl		Production of organic compounds
000091952	4111	DV87500	(I)	3,3'-diaminobenzidine		Copolymerized to make high-temperature-resistant polybenzimidazole textile fibers
000060015	4111	ET73500	(I)	tributyrin; glyceryl tributyrate		Plasticizer; synthetic flavoring substance and adjuvant

Footnotes: see pp. 23 and 24.

TABLE 1. (SECTION A continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000131737	4111	JJ92750	(I)	dipicrylamine; hexanitrodiphenylamine		Analytical reagent for potassium determination; explosive booster
000593828	4111	MV29000	(I)	1,1-dimethylhydrazine hydrochloride	ID[k]	Chemical intermediate
006080564	4111	OF80500	(I)	lead acetate trihydrate	AP	Medicine; lead salts; dyeing textiles, waterproofing; varnishes; insecticides; antifouling paints; analytical reagent
000108441	4111	XU28000	(I)	3-methylbenzenamine; m-toluidine		Manufacture of dyes and organic chemicals
000095534	4111 (4212)	XU29750	(I)	2-methylbenzenamine; o-toluidine		Manufacture of dyes (makes colors fast to acids)
000136356	3122	XY26250	(I)	diazoaminobenzene		Insecticide; organic synthesis; dyes
000106514	3121	DK26250	(I)	quinone		Oxidizing agent in photography; manufacture of dyes; strengthening animal fibers
000100403	3121	CW66500	(I)	4-vinylcyclohexene	ID	Intermediate to produce vinylcyclohexene dioxide (a reactive diluent in epoxy resins)
000130154	3121	QL71750	(I)	1,4-naphthoquinone		Polymerization regulator for rubber and polyester resins, synthesis of dyes and pharmaceuticals; fungicide; algicide
010028156	3121	RS82250	(I)	ozone		Manufacture of bleaches, waxes, textiles; disinfectant for air and water
000095578	3121	SK26250	(I)	o-chlorophenol		Organic synthesis (dyes)
000120832	3121	SK85750	(I)	2,4-dichlorophenol		Organic synthesis
000078955	3121	UC07000	(I)	chloroacetone[f]		Manufacture of couplers in color photography; insecticide formulations; intermediate in manufacture of dyes and perfumes
000590921	3121	UK78750	(I)	3-bromopropionic acid		Organic intermediate
000105679	3121	ZE56000	(I)	2,4-xylenol		Disinfectants; solvents; pharmaceuticals; insecticides and fungicides; plasticizers; rubber chemicals; additives to lubricants and gasolines; wetting agents; dyestuffs; 2,6-xylenol used to manufacture polyphenyleneoxide
000095874	3121	ZE57750	(I)	2,5-xylenol		
000576261	3121	ZE61250	(I)	2,6-xylenol		
000095658	3121	ZE63000	(I)	3,4-xylenol		

Footnotes: see pp. 23 and 24.

TABLE I. (SECTION A CONTINUED)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000092671	5416	DU89250	[illegible]	p-biphenylamine; 1,1'-(biphenyl)-4-amine	HP(C)	Analytical reagent to detect sulfates; positive carcinogen in cancer research (apparently, no commercial production)
000092933	5111	DV56000	(—)	4-nitrobiphenyl	AP(C)	Chemical intermediate to produce 4-aminobiphenyl; organic research
000062759	4429	IQ05250	—	N-nitrosodimethylamine; DMNA	AP(C)	Manufacture of rocket fuels; solvents; organic research
000057578	4428	RQ73500	—	beta-propiolactone	AP(C)	Disinfectant; intermediate in organic synthesis; vapor sterilant
004245776	4326 (5427)	MF22750	(—)	N-ethyl-N'-nitro-N-nitrosoguanidine		Explosives; biological research
001464535	4222 (4101)	EJ82250	—	1,2:3,4-diepoxybutane		Curing polymers; crosslinking textile fibers; preservative
004223103	4222	RN86400	(—)	vinylcyclohexene dioxide	ID[l]	Manufacture of polymers; reagent in organic synthesis
000140794	4214	TL63000	-	N,N'-dinitrosopiperazine		Intermediate in organic synthesis
001120714	4213	RP54250	-	propane sultone	AP	Chemical intermediate to introduce sulfopropyl groups; (production discontinued in 1975)
000148243	4213	VC42000	(—)	8-hydroxyquinoline	ID[m]	Antibacterial-antifungal agent; deodorant; for precipitating and separating metals; analytical reagent to detect bismuth
011097691	4212	TQ13600	(--)[n]	Aroclor 1254[R]	AP	(PCB) Dielectric liquids for closed electrical systems
037317412[o]	4212	TQ13760	(--)[n]	Kanechlor 500[R]	AP	(PCB) Dielectric liquids for closed electrical systems
000099809	4112	BX93500	—	N,4-dinitroso-N-methyl-aniline	ID	Rubber additive (retarder with antioxidant and anti-flex-cracking properties)
000138896	4111	BX71750	(—)	4-nitroso-N,N-dimethylaniline; accelerine		Manufacture of organic compounds; printing dyes; accelerator in vulcanizing rubber
_____	4111	OF67300	(--)	LD-813		(Commercial mixture of aromatic amines - containing 40% MOCA)

_____

Footnotes: see pp. 23 and 24.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000097778	3112	JO12250	(I)	disulfiram; Antabuse[R]	ID	Treatment of alcoholism; antioxidant in vulcanizing rubber (accelerator and cure retarder); seed disinfectant; fungicide
000103162	3112	SJ77000	(I)	monobenzone		Rubber processing; depigmentation pharmaceutical
001701775	3111	AI89600	(I)	methoxyphenyl-acetic acid		Preparation of pharmaceuticals and other compounds
000094586	3111	DA61250	(I)	dihydrosafrole	AP	Essential oil compositions; chemical intermediate (use as food additive banned in U.S.)
000118752	3111	DK68250	(I)	chloranil; tetrachloro-quinone		Seed-protecting fungicide; dye intermediate; vulcanizing agent
000101735	3111	JJ95000	(I)	p-isopropoxydi-phenylamine		Rubber antioxidant
002385855	3111	PC82250	(I)	mirex; Dechlorane[R]	AP	Insecticide; fire retardant
000136925	3111	VT07000	(I)	ethyl Selenac[R]; selenium diethyl-dithiocarbamate	ID	Accelerator in rubber processing; compounding rubbers; fungicide
000057567	3111	VT29750	(I)	semicarbazide; aminourea		Production of semicarbazide hydrochloride (reagent for aldehydes and ketones); isolation of hormones and fractions from essential oils

Minor Commercial Significance (annual production apparently below 1000 lb)

DYES, DYE INTERMEDIATES

000492171	5111	DV21000	(—)	diphenyline; 2,4'-biphenyldiamine		Manufacture of azo dyes; analytical reagent to detect tungsten
000056575	4529	VC21000	(—)	4-nitroquinoline-N-oxide		Organic synthesis
000494382	4222	AR76000	(—)	Acridine Orange base; CI 46005B		Dye for wool, silk, and leather; manufacture of acriflavine
000492808	4213	BY35000	(—)	auramine base; CI 41000B	HP	Manufacture of auramine O and Solvent Yellow 34; antiseptic; dyeing of paper, cardboard, textiles, and leather

Footnotes: see pp. 23 and 24.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
003564098	4212 (4213)	QJ66500	(—)	Ponceau 3R; CI 16155	AP	Used for dyeing wool; (delisted by FDA for use in foods, drugs, and cosmetics)
005141208	4112	BQ49000	(—)	Light Green SF Yellowish; CI 42095		Dye
000099058	4111	DG12250	(—)	3-aminobenzoic acid		Dye intermediate
006368725	4111	QH28500	--	Sudan Red 7B; CI 26050	ID	Dye; colorant for waxes, polishes, solvents, petroleum products, and plastics
000085847	4111	QH47250	(—)	Yellow AB; CI 11380	(N)	(Formerly used to color oleomargarine); colorant for oil and spirit products, biological stain; (prepared from beta-naphthylamine, a carcinogen, which remains present as an impurity)
006416575	4111	ST29000	--	Sudan Brown RR; CI 11285	ID	Dye; colorant for waxes, polishes, solvents, petroleum products, and plastics
000084117	3121	SF78750	(—)	phenanthrenequinone		Organic synthesis; dyes
000085825	3112	QL59500	(—)	FD&C Red No. 32		Isomer of Sudan II; colorant for waxes, polishes, petroleum products, and plastics
MISCELLANEOUS						
000055185	6929	IA35000	—	N-nitrosodiethylamine; DENA	AP	Gasoline and lubricant additive; antioxidant; stabilizer; fiber solvent; copolymer softener; in condensers to increase dielectric constant
000056495	5829	FZ36750	(—)	methylcholanthrene		Organic synthesis; from combustion of petroleum products
000057976	5729	CW38500	(—)	7,12-dimethylbenz(a)-anthracene[p]		Organic synthesis; from combustion of petroleum products
000053963	5529 (5729)	AB94500	(--)	2-FAA; N-2-fluorenylacetamide	(C)	Organic synthesis; (formerly an experimental insecticide)

Footnotes: see pp. 23 and 24.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000545551	4111	SZ17500	(—)	tris(1-aziridinyl)-phosphine oxide	ID	Antineoplastic agent; clothing dye; photographic emulsion hardener; insect chemosterilant; textile applications
011096825	4111	TQ13620	(—)[n]	Aroclor 1260[R]		(PCB) Dielectric liquids for closed electrical systems
037353632[o]	4111	TQ13720	(—)[n]	Kanechlor 300[R]	AS	(PCB) Dielectric liquids for closed electrical systems
012737870[o]	4111	TQ13740	(—)[n]	Kanechlor 400[R]	AS	(PCB) Dielectrical liquids for closed electrical systems
000079447	3123 (4224)	FD42000	—	dimethylcarbamoyl chloride	AP	Chemical intermediate in manufacture of drugs, herbicides, pesticides, and anthelmintics
010124502	3121 (7222)	CG35000	—	potassium arsenite	HS	Silvering mirrors (reduces the silver salt to metallic silver)
000564001	3121	EJ87500	(—)	meso-1,2:3,4-diepoxy-butane	AP	Organic research (very limited production appears likely); see EJ82250
000096082	3121	OS91000	—	limonene dioxide		Organic intermediate; manufacture of epoxy resins
000512856	3121	OT01750	(—)	ascaridole		Anthelmintic; polymerization initiator
000108689	3121	ZE64750	(—)	3,5-xylenol		Component of commercial xylenol mixtures; see ZE56000, ZE57750, ZE61250, ZE63000
014239680	3112	EU98500	(—)	cadmium diethyl dithiocarbamate		Accelerator for butyl rubber
000156627	3111	GS60000	(—)	calcium cyanamide; lime nitrogen		Herbicide; fertilizer; nitrogen products; iron and steel hardener
006385586	3111	SN07000	(—)	sodium bithionolate		Antimicrobial agent to control bacteria, molds, and yeast
000060344	2111 (3212)	MV56000	—	methylhydrazine		Used in rocket fuels; intermediate in chemical synthesis

Footnotes: see pp. 23 and 24.

TABLE 1. (SECTION B)

B) Pesticides

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	NAME	IARC REVIEW[c]	REPORTED USES[d]
000054626	4222	MA10500	aminopterin		Rodenticide; antineoplastic agent
000060571	4212	IO17500	dieldrin	AP	Insecticide
000072548	4212	KI07000	TDE; DDD	AP	Insecticide
000150685	4212	YS63000	monuron	AP	Herbicide (no longer EPA registered)
000061825	4212	XZ38500	amitrole; aminotriazole	AP	Herbicide
000063252	4112	FC59500	Sevin[R]; carbaryl	ID	Contact insecticide; parasiticide (vet.)
000077463	4111	AE71750	Acedapsone[R]; Rodilone[R]		Antibacterial agent
000309002	4111	IO21000	aldrin	ID	Insecticide
000645056	4111	OS10500	hemel; hexamethylmelamine		(1971, ITC listed) not sold in U.S.; chemosterilant for insects
000082688	3122	DA66500	quintozene; PCNB	AP	Fungicide for seeds and soil
000117180	3121	DC01750	2,3,5,6-tetrachloro-nitrobenzene		Soil fungicide
000101995	3121	FD89250	phenylurethan(e)		Plant growth regulator
000120627	3112	DA57750	sulfoxide		Insecticide; synergist for pyrethrins
000133062	3112	GW50750	captan		Bacteriostat in soaps; fungicide in agriculture (seeds), paints, plastics, leather, fabric, and fruit preservation
000053190	3112	KH78800	o,p'-TDE; o,p'-DDD	AS	Antineoplastic agent; constituent of commercial TDE(DDD)
000051036	3112	XS80500	piperonyl butoxide		Synergist for pyrethrins and insecticides
000999815	3111	BP52500	Cycocel[R]		Plant growth regulator
000080331	3111	DB52500	ovex		Insecticide; herbicide; acaricide
000510156	3111	DD22750	chlorobenzilate	AP	Insecticide; miticide
002303164	3111	EZ82250	di-allate	AP	Herbicide
000315184	3111	FC07000	mexacarbate; zectran		Insecticide, molluscicide, and acaricide for lawns and flowers; (not EPA registered for food crops)

Footnotes: see pp. 23 and 24.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	NAME	IARC REVIEW[c]	REPORTED USES[d]
000128041	3111	FD35000	sodium dimethyl-dithiocarbamate		Fungicide
000101213	3111	FD80500	chloro-IPC	ID	Pre- and post-emergence herbicide
000122429	3111	FD91000	IPC; Propham[R]	ID	Pre- and post-emergence herbicide
000319846	3111 (4212)	GV35000	alpha-lindane	AP	Insecticide
000319857	3111	GV43750	beta-lindane	AP	Insecticide
000058899	3111	GV49000	gamma-lindane	ID	Insecticide
000072560	3111	KH57900	Perthane[R]		Insecticide
000050293	3111	KJ33250	DDT	AS	Insecticide
000072559	3111	KV94500	DDE		Degradation product of DDT found as an impurity in DDT residues
000297789	3111	PC12250	isobenzan		Insecticide
000115297	3111	RB92750	endosulfan		Insecticide
000088857	3111	SJ98000	dinoseb		Insecticide; herbicide; ovicide; (increases corn yield 5-10%)
000088062	3111	SN15750	2,4,6-trichlorophenol		Herbicide; fungicide; defoliant; preservative
000900958	3111	WH66500	triphenyltin acetate		Fungicide; antifeeding compound for insect pest control
000140578	3111 (5313)	WT29750	Aramite[R]	AP	Acaricide

Footnotes: see pp. 23 and 24.

[a]New OTS rank in parentheses assigned from data contained in Suspected Carcinogens - A Subfile of the Registry of Toxic Effects of Chemical Substances (2nd Ed.), 1976. [When the route of administration is unknown, the highest exposure level (2) is assigned.]

[b]Production Key

-- = known <10^3 lb; production figures available (IARC, EPA/OTS-1977, or elsewhere)

(--) = assumed <10^3 lb since not listed in the Directory of Chemical Producers (DCP)

(I) = >10^3 lb; listed in DCP (no production figures available; however, inclusion in the DCP implies that a chemical has a production level greater than 1,000 pounds on total sales in excess of $1,000)

I = >10^3 lb; production figures available U.S. International Trade Commission (ITC), IARC, EPA/OTS-1977, or elsewhere

II = >10^5 lb; production figures available ITC or elsewhere

III = >10^6 lb; production figures available ITC or elsewhere

IV = >10^7 lb; production figures available ITC or elsewhere

V = >10^9 lb; production figures available ITC or elsewhere

[c]IARC Review: Evaluation of carcinogenicity data on chemicals as reported by the International Agency for Research on Cancer (IARC) in their publication IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man (Vols. 1-13)

HP - Human Positive

HS - Human Suspected

AP - Animal Positive

AS - Animal Suspected

ID - Indefinite

(N) - Negative

[(C) - U.S. Occupational Standard-Carcinogen, as determined from NIOSH hazard review documents]

[d]Sources consulted for use information are listed in References.
Organic research: compounds synthesized as experimental carcinogens or as analogs to complete a structural series or class, analytical reagents, or laboratory curiosities.

[e]Combined production of anhydrous hydrazine and hydrazine hydrate estimated at 37 million pounds in 1974.

[f]This substance was (apparently) deleted erroneously from the RTECS Subfile (1976).

[g]While there is little apparent domestic production of thiourea, an estimated 3.7 million pounds were imported in 1973.

TABLE 1 (continued)

[h] The name "urethane" is often applied to high molecular weight "polyurethanes" used as foams (insulation), elastomers, and coatings. However, these products are not made from the chemical urethane and do not generate it on decomposition.

[i] No information is available on the domestic production of o-tolidine; however, imports in 1970 totaled 98,000 pounds.

[j] No IARC Review noted in the RTECS Subfile (1976); however, lead acetate trihydrate, which is equivalent to approximately 86% lead acetate, is AP.

[k] No IARC Review noted in the RTECS Subfile (1976); however, because 1,1-dimethylhydrazine is AP, the addition of the hydrochloride might not change its carcinogenic effect on the animals tested.

[l] AP IARC Review noted in the RTECS Subfile (1976); however, the IARC Monograph reviewed an isomer with CAS NO. 106-87-6 (both substances are stereoisomeric and share the common name vinylcyclohexene dioxide). The isomer reviewed in the IARC Monograph indicates an ID Review.

[m] No IARC Review noted in the RTECS Subfile (1976); however, IARC Monograph indicates ID Review.

[n] Restricted use as required by Section 6(e) of the Toxic Substances Control Act (P.L. 94-469) and regulations being proposed and promulgated under this section.

[o] CAS No. as reported in the TSCA Candidate List of Chemical Substances (April 1977).

[p] This compound is identified also be a second CAS No.

[+] NEO or CAR notation deleted from 1976 edition of the Suspected Carcinogens Subfile of the Registry of Toxic Effects of Chemical Substances. After reviewing the primary references cited in the 1975 edition, it was determined that this chemical's inclusion in the 1975 Subfile was erroneous.

[R] Registered trademark.

TABLE 2. CHEMICALS FROM THE NIOSH SUBFILE OF SUSPECTED CARCINOGENS (1975) WHICH APPEAR TO BE OF GREATER IMPORTANCE UNDER OTHER REGULATORY AUTHORITY

A) Food-Cosmetic Related Chemicals

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	NAME	IARC REVIEW[b]	REPORTED USES[c]
000081072	4212	DE42000	saccharin		Artificial sweetener
000139060	4112	GV71000	calcium cyclamate		Artificial sweetener (no longer used)
000150696	4111	YT22750	sucrol; dulcin	ID	Artificial sweetener (no longer used)
000120581	3111	DA59500	isosafrole	AP	To produce perfume, flavors, pesticide synergists, and heliotropen

B) Pharmaceuticals

000302227	5111	TU37500	chlormadinone acetate	AS	Progestational agent
000595335	5111	TU40750	megestrol acetate		Progestational agent (mixture as oral contraceptive); antineoplastic agent (vet.)
000054853	4214	NS17500	isoniazid	AP	Antitubercular agent
000366701	4214	XS47250	procarbazine hydrochloride		Antineoplastic agent
000072140	4212	WP23600	sulfathiazole		Antibacterial agent
000121595	4111	CP92750	carbarsone		Amoebicide
000059870	4111	LT77000	nitrofurazone	ID	Antibacterial agent
000057410	4111 (4212)	MU10500	phenytoin; 5,5-diphenylhydantoin	HS[d]	Anticonvulsant; antiseptic
021083476	4111	MU17500	5,5-diphenyl-2-thiohydantoin		Pharmaceutical analog synthesized for research
000551928	4111	NI50750	dimetridazole		Antihistomonad (vet.)
000555840	4111	NJ08750	nifuradene	AP	Antibacterial agent
000057636	4111 (4212)	RC89250	Lynoral[R]; ethinyl estradiol	AP	Action and use of estrogen in contraception
000723466	4111	WP07000	sulfamethoxazole		Antibacterial agent
003565159	4111	YR06000	itrumil sodium; 5-iodo-2-thiouracil		Antithyroid agent

Footnotes: see p. 28.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	NAME	IARC REVIEW[b]	REPORTED USES[c]
000056042	4111	YR08750	methylthiouracil	AP	Antithyroid agent
000051525	3313	YR14000	propylthiouracil	AP	Antithyroid agent
000055867	3124	IA21000	mechlorethamine hydrochloride; nitrogen mustard hydrochloride	AP	Antineoplastic agent
000055981	3122	EK17500	busulfan	AS	Antineoplastic agent
000305033	3122 (4223)	ES75250	chlorambucil	AP	Antineoplastic agent
000051183	3122 (4223)	XZ21000	tretamine; triethylenemelamine	AP	Antineoplastic agent; manufacture of resinous products and textile finishing agents outside U.S.
010345948	3121	AY35000	medphalan; D-sarcolysine	ID	Antineoplastic agent (vet.)
000148823	3121 (7324)	AY36750	melphalan; L-sarcolysine	HS	Antineoplastic agent; insect chemosterilant
000480228	3121	CB12250	Dithranol[R]	AS[e]	Dermatologic; antifungal (vet.)
000076200	3121	EJ52500	Trional[R]; methylsulfonal		Hypnotic
000302170	3121	FM87500	chloral hydrate[f]		Sedative; hypnotic; to manufacture liniments and DDT
000064868	3121	GH07000	colchicine		Alkaloid to treat gout; to induce chromosome doubling in plants
000091645	3121 (4222)	GN42000	coumarin	AP	Deodorizing and odor-enhancing agent; pharmaceutical preparations
000056257	3121	RN85750	cantharidin	AS	Vesicant
000123637	3121	YK05250	paraldehyde		Hypnotic; solvent; chemical intermediate
000077656	3121	YS29750	carbromal		Sedative; hypnotic
000126078	3112	WG98000	griseofulvin	AP	Antifungal; antibiotic
+000050066	3111	CQ68250	phenobarbital		Barbiturate
000059052	3111	MA12250	methotrexate		Antineoplastic agent; insect chemosterilant

Footnotes: see p. 28.

TABLE 2. (SECTION B continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	NAME	IARC REVIEW[b]	REPORTED USES[c]
000443481	3111	NI56000	Flagyl[R]; metronidazole	AP[R]	Antiprotozoan drug (trichomonicide)
000536334	3111	NS03500	ethionamide	AP[R]	Tuberculostatic drug
003804895	3111	NS22750	Neo-Tizide[R]; isoniazid methanesulfonate, sodium salt		Tuberculostatic drug
000072333	3111	RC89600	ethinylestradiol 3-methyl ether	AP	Progestational agent
000097187	3111	SN05250	bithionol		Antibacterial, antimold, antiyeast (surfactant-formulated antimicrobial)
000098964	3111	UQ22750	pyrazinamide		Tuberculostatic drug
000141902	3111	YR15750	thiouracil	AP	Formerly used as an antithyroid agent and to treat congestive heart failure and angina pectoris

Footnotes: see p. 28.

TABLE 2 (continued)

[a]New OTS rank in parentheses assigned from data contained in Suspected Carcinogens - A Subfile of the Registry of Toxic Effects of Chemical Substances (2nd Ed.), 1976. [When the route of administration is unknown, the highest exposure level (2) is assigned.]

[b]IARC Review: Evaluation of carcinogenicity data on chemicals as reported by the International Agency for Research on Cancer (IARC) in their publication IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man (Vols. 1-13)

HP - Human Positive

HS - Human Suspected

AP - Animal Positive

AS - Animal Suspected

ID - Indefinite

(N) - Negative

[(C) - U.S. Occupational Standard-Carcinogen, as determined from NIOSH hazard review documents]

[c]Sources consulted for use information are listed in References.

[d]No IARC Review noted in the RTECS Subfile (1976); however, the IARC Monograph indicates an HS Review.

[e]No IARC Review noted in the RTECS Subfile (1976); however, the IARC Monograph indicates an AS Review. (Dithranol is a tumor-promoting agent in mouse skin carcinogenesis experiments following initiation with either 7,12-dimethylbenz[α]anthracene or urethane. An increased incidence of lymphomas was also observed in mice painted with dithranol after urethane initiation--IARC Monographs).

[f]This substance was (apparently) erroneously deleted from the RTECS Subfile (1976).

[g]No IARC Review noted in the RTECS Subfile (1976); however, the IARC Monograph indicates an AP Review.

+NEO or CAR notation deleted from 1976 edition of Suspected Carcinogens Subfile of the Registry of Toxic Effects of Chemical Substances. After reviewing the primary reference cited in the 1975 edition, it was determined that this chemical's inclusion in the 1975 Subfile was erroneous.

[R]Registered trademark.

TABLE 3. CHEMICALS FROM THE NIOSH SUBFILE OF SUSPECTED CARCINOGENS (1975)
FOR WHICH LITTLE OR NO INFORMATION CONCERNING COMMERCIAL IMPORTANCE WAS FOUND

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
_____	6222	DS29750	(—)	beryllium hydrogen phosphate (1:1)	AP	Occurs in beryllium refining
000070257	5429	MF42000	—	N-methyl-N'-nitro-N-nitrosoguanidine; MNNG	AP	Organic research; preparation of diazomethane
000531828	5414	AC66500	—	furathiazole; NFTA	AP	Chemotherapeutic agent; antibiotic for infections of the urinary tract
024554265	5414	LQ31500	—	N-(4-(5-nitro-2-furyl)-2-thiazolyl)formamide		Organic research
000053703	4529	HN26250	(—)	dibenz(ah)anthracene	AP	Occurs from combustion of coal tar and petroleum products
000053952	4519	AK85750	(—)	N-hydroxy-2-acetylaminofluorene		Organic synthesis
000924163	4418	EJ40250	—	N-nitrosodibutylamine; DBNA	AP	Organic research
000615532	4418 (4419)	FC63000	—	N-methyl-N-nitrosourethan(e)[e]	AP	Organic research
000100754	4315	TN21000	—	N-nitrosopiperidine		Organic research
003570750	4313	LQ92750	—	nifurthiazole	AP	Organic research
014901087	4313 (4314)	LZ59500	—	cycasin	HS	Formerly to make starch; (plant extract)
000306376	4313	HV28000	(—)	1,2-dimethylhydrazine dihydrochloride		Analytical reagent
000059892	4313 (4314)	QE75250	—	4-nitrosomorpholine		Organic research
002373980	4226	DV49000	(—)	3,3'-dihydroxybenzidine		Organic research; (benzidine metabolite)
002541697	4225	CX15750	(—)	7-methylbenz(a)anthracene		Occurs from combustion of coal tar and petroleum products
000153786	4225	LL50750	(—)	2-fluorenamine		Organic synthesis (experimental antitumor agent)

Footnotes: see p. 38.

TABLE 3. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
004637563	4225	VB98000	(—)	4-(hydroxyamino)-quinoline 1-oxide		Organic research
002422799	4224	CX24500	(—)	12-methylbenz(a)-anthracene		Occurs in combustion of coal tar and petroleum products
000542881	4224 (4226)	KN15750	--	bis(chloromethyl) ether	HP(C)	Contaminant of chloromethyl methyl ether
000334883	4223	PA70000	(—)	diazomethane	AP	Laboratory methylating agent
000057976[f]	4222	CW43750	(—)	7,12-dimethylbenz(a)-anthracene		Organic synthesis; occurs in the combustion of coal and petroleum products
000759739	4215 (4429)	YT31500	--	ethylnitrosourea	AP	Laboratory reagent to synthesize diazoethane
001162658	4214	GY19250	--	aflatoxin-B1	AP	Secondary fungal metabolite (mycotoxin)
001010613	4214 (4215)	VC01750	(—)	4-(hydroxyamino)-quinoline 1-oxide, hydrochloride		Organic research
000568752	4213 (4224)	CW87500	(—)	7-hydroxymethyl-12-methylbenz(a)-anthracene		Occurs in combustion of coal tar and petroleum products
002130565	4213	DV33250	(—)	3,3'-dicarboxybenzidine		Organic research
000614959	4213	FB03500	(—)	N-ethyl-N-nitrosourethan(e)[e]		Organic research
000066273	4213 (4225)	PB26250	--	methyl methanesulfonate; MMS	AP	Organic research
000869012	4213	YS38500	(—)	N-butyl-N-nitrosourea		Experimental laboratory reagent
013256138	4213	YZ07000	(—)	N-nitroso-N-ethylvinylamine		Organic research
000304289	4212	AC07000	(—)	2,7-diacetylamino-fluorene		Organic research
004120789	4212	AC73500	(—)	N-3-phenanthrenylacetamide		Organic research
000614006	4212 (4213)	BY57750	(—)	N-nitroso-N-methylaniline		Organic research
002580781	4212	CB10500	(—)	CI Reactive Blue 19		Organic research

Footnotes: see p. 38.

TABLE 3. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000932832	4212	CM33250	(—)	N-nitrosohexamethyl-eneimine		Organic research
020917491	4212 (4213)	CM49000	(—)	octahydro-1-nitrosoazocine		Organic research
000568707	4212	CW89250	(—)	12-methanol-7-methylbenz(a)-anthracene		Occurs in combustion of coal tar and petroleum products
000055801	4212	CY03500	(—)	3-methyl-4'-(dimethyl-amino)azobenzene		Organic research
013256229	4212	VQ31500	--	N-nitrososarcosine		Organic research
026049694	4212	XJ46000	(—)	2-(2,2-dimethylhydra-zino)-4-(5-nitro-2-furyl)thiazole		Experimental carcinogen
026049683	4212	XJ49000	(—)	2-hydrazino-4-(5-nitro-2-furyl)thiazole		Experimental carcinogen
026049707	4212	XJ50750	(—)	2-hydrazino-4-(4-nitro-phenyl)thiazole		Experimental carcinogen
004549433	4122 (4112)	BA70000	(—)	N-nitrosomethylallylamine		Organic research
003544238	4122	BZ73500	(—)	3-methoxy-4-aminoazobenzene		Organic research
007068839	4122	EO54250	--	N-methyl-N-butylnitrosamine		Organic research
018559972	4114	AE70000	(—)	4-acetamidostilbene		Organic research
000592621	4114 (4115)	PC28000	(—)	methylazoxymethanol acetate	AP	Organic research
022225327	4113	AK87500	(—)	N-hydroxy-3-fluorenyl-acetamide		Organic research
007227910	4113 (4115)	XY21000	--	3,3-dimethyl-1-phenyltriazene		Organic research
006893205	4112	AC57750	(—)	1-methoxy-2-acetamido-fluorene		Organic research
004120778	4112	AC71750	(—)	N-2-phenanthrenylacetamide		Organic research

Footnotes: see p. 38.

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000621909	4112	BY59500	(—)	N-methyl-4-aminoazobenzene		Organic research
003671714	4112	DG03500	(—)	N-hydroxy-N-2-fluorenylbenzamide		Organic research
010048132	4112 (4123)	LV17500	(—)	sterigmatocystin	AP	Metabolite of Aspergillus versicolor
013256070	4112	SC12250	(—)	N-methyl-N-nitrosopentylamine		Organic research
010048325	4112	UQ05250	(—)	parasorbic acid	AS	Natural acidifying agent in food
013256230	4112	UT36750	(—)	4-((ethylnitrosamino)-methyl)pyridine		Organic research
013344508	4112	VQ33250	--	N-nitrososarcosine ethyl ester		Organic research
000625229	4112	WS77000	(—)	dibutyl sulfate		
016690441	4111	AC59500	(—)	N-(7-methoxy-2-fluorenyl)acetamide		Organic research
000843345	4111	AE42800	(—)	4'-hydroxy-4-acetamidostilbene		Organic research
018997621	4111	BX87500	(—)	N,N-dimethyl-4-(2,3-dimethylphenyl)-azo)aniline		Organic research
017210489	4111	BZ66500	(—)	3,4'-dimethyoxy-4-aminoazobenzene		Organic research
020917504	4111	CO17500	(—)	N-nitroso-octamethyleneimine		Organic research
018463860	4111	DB5750	(—)	N,N-dimethyl-4-benzimidazol-4-ylazo)aniline		Organic research
018463859	4111	DL38500	(—)	N,N-dimethyl-4-(6-benzothiazolylazo)-aniline		Organic research
018559927	4111	DL40250	(—)	N,N-dimethyl-4-(7-benzothiazolylazo)-aniline		Organic research
001628586	4111	DL42000	(—)	p-(dimethylamino)-styrlbenzothiazole		Organic research

Footnotes: see p. 38.

TABLE 3. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000937406	4111	DP63000	(—)	N-methyl-N-nitroso-benzylamine		Organic research
[g]	4111	DV03500	(—)	4'-nitro-4-biphenylamine		Organic research
003817116	4111 (4212)	EL12250	(—)	N-butyl-N-(4-butanol) nitrosamine		Organic research
[h]	4111	EO51000	(—)	N-ethyl-N-nitroso-t-butylamine		Organic research
000067210	4111	ES70000	(—)	DL-ethionine		Experimental pharmaceutical
010087895	4111	GU71750	(—)	1,1-diphenyl-2-propynyl-N-cyclohexylcarbamate		Organic research
005432280	4111	GX15750	(—)	N-methyl-N-nitroso-cyclohexylamine		Organic research
000203643	4111	GY56000	(—)	4H-cyclopenta(def)-phenanthrene		Organic research
005834173	4111	HP49000	(—)	2-methoxy-3-amino-dibenzofuran		Organic research
[i]	4111	HP87500	(—)	N-(6-oxo-6H-dibenzo(b,d)-pyran-1-yl)acetamide		Organic research
002581693	4111	JJ97000	(—)	4-((p-nitrophenyl)azo)-diphenylamine		Organic research
007346147	4111	KV36750	(—)	N,N'-dinitroso-N-N'-diethyl-1,2-ethanediamine		Synthesized as a possible antitumor agent
013256127	4111	KV43750	(—)	N,N'-dinitroso-N-N'-dimethyl-1,2-ethanediamine		Synthesized as a possible antitumor agent
006893249	4111	LL54250	(—)	1-methoxyfluoren-2-amine, hydrochloride		Organic research
000525644	4111	LL69800	(—)	2,7-diaminofluorene		Laboratory reagent
000129793	4111	LL91000	(—)	2,4,7-trinitrofluoren-9-one		Organic research
005036033	4111	NJ07000	(—)	1-(2-hydroxyethyl)-3-(((5-nitro-2-furanyl)-methylene)amino)-2-imidazolidinone		Synthesized as a possible urinary tract antibacterial agent

Footnotes: see p. 38.

TABLE 3. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
017309874	4111	NK79300	(--)	N,N-dimethyl-p-(6-indazylazo)aniline		Organic research
019471273	4111	OL01750	(--)	N,N-dimethyl-4-((2,5-dimethyl-4 pyridinyl)azo) aniline, N-oxide		Organic research
014816672	4111	PB05250	(--)	soterenol hydrochloride		Formerly an adrenergic stimulant pharmaceutical
002401856	4111	QJ24500	(--)	1-chloro-2,4-dinitro-naphthalene		Organic research
006240557	4111	QJ36750	(--)	1,2-dichloro-3-nitro-naphthalene		Organic research
005096184	4111	QM42000	(--)	3-methyl-2-naphthyl-amine, hydrochloride		Organic research
013115281	4111	QM43750	(--)	3-nitro-2-naphthyl-amine		Organic research
004176538	4111	SF94500	(--)	1-phenanthrenamine		Organic research
001892542	4111	SF98000	(--)	3-phenanthrenamine		Organic research
000947739	4111	SG01750	(--)	9-phenanthrenamine		Organic research
003851169	4111	TH75250	(--)	N,N'-dimethyl-N,N'-dinitrosophthalamide		Organic intermediate
019456736	4111	UT22750	(--)	N,N,2,3-tetramethyl-4(4-pyridinylazo)aniline, N-oxide		Organic research
019456758	4111	UT24500	(--)	N,N,2,5-tetramethyl-4-4(4-pyridinylazo)aniline, N-oxide		Organic research
017416181	4111	UZ98000	(--)	2'-methyl-5'-(p-dimethylamino-phenylazo)quinoline		Organic research
017416170	4111	VB54250	(--)	5-(p-dimethylamino-phenylazo)quinoline		Organic research
017400690	4111	VB57750	(--)	3'-methyl-5'-(p-dimethylamino-phenylazo)quinoline		Organic research

Footnotes: see p. 38.

TABLE 5. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
017400703	4111	VB59500	(—)	6'-methyl-5'-(p-dimethyl-aminophenylazo)-quinoline		Organic research
017400656	4111	VB61250	(—)	7'-methyl-5'-(p-dimethyl-aminophenylazo)-quinoline		Organic research
017416205	4111	VB63000	(—)	8'-methyl-5'-(p-dimethyl-aminophenylazo)-quinoline		Organic research
019716213	4111	VB71750	(—)	4-(p-(dimethylamino)-styryl)-6,8-dimethylquinoline		Organic research
017400689	4111	VB75250	(—)	3-methyl-5'-(p-dimethyl-aminophenylazo)-quinoline		Experimental carcinogen
017416216	4111	VB77000	(—)	2-methyl-5'-(p-dimethyl-aminophenylazo)quinoline		Organic research
004008484	4111	VC82250	(—)	5-nitro-8-hydroxyquinoline		Organic research
023521133	4111	VD19800	(—)	5-(p-dimethylamino-phenylazo)quinoxaline		Organic research
023521144	4111	VD20000	(—)	6-(p-(dimethylamino-phenylazo)quinoxaline		Organic research
000838959	4111	WJ40250	(—)	cis-4-dimethylamino-stilbene		Organic research
013256218	4111	XN08000	(—)	N-nitrosomethylamino-sulfolane		Organic research
000626482	4111	YR07000	(—)	6-methyluracil		Organic synthesis
000189559	3225	DI57750	(—)	3,4:9,10-dibenzopyrene	AP	Occurs in combustion of coal tar and petroleum products
000056553	3124	CV92750	(—)	benzanthrene	AP	Occurs in combustion of coal tar and petroleum products
000652040	3124	DI94500	(—)	5-methylbenzo(c)-phenanthrene		Occurs in combustion of coal tar and petroleum products

Footnotes: see p. 38.

TABLE 3. (continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000226368	3124	HN08750	(—)	dibenz(ah)acridine	AP	Occurs in combustion of coal tar and petroleum products
000205992	3122	CU14000	(—)	benzo(b)fluoranthene	AP	Occurs in combustion of coal tar and petroleum products; in smoked fish and meats
000207089	3122	DF63500	(—)	benzo(k)fluoranthene		Occurs in combustion of coal tar and petroleum products
000105408	3122	FC26250	(—)	N-methyl urethan(e)[e]		Organic synthesis
000479232	3122	FZ26250	(—)	cholanthrene		Organic synthesis
000218019	3122	GC07000	(—)	chrysene	AP	Organic synthesis
000224420	3122	HN10500	(—)	dibenz(a,j)acridine	AP	Occurs in combustion of coal tar and petroleum products
000192654	3122	QL01750	(—)	dibenzo(a,e)pyrene	AP	Occurs in combustion of coal tar and petroleum products
000225514	3121	CU29750	(—)	benz(c)acridine	AP	Occurs in combustion of coal tar and petroleum products
000205823	3121	DF63000	(—)	benzo(j)fluoranthene	AP	Occurs in combustion of coal tar and petroleum products
000195197	3121	DI82250	(—)	benzo(c)phenanthrene		Occurs in combustion of coal tar and petroleum products
000192972	3121 (3223)	DJ42000	(—)	benzo(e)pyrene	AS	Occurs in combustion of coal tar and petroleum products
005929011	3121	DJ78750	(—)	1:2-benzopyrene picrate		Occurs in combustion of coal tar and petroleum products
000215587	3121	DM19250	(—)	dibenz(ac)anthracene		Occurs in combustion of coal tar and petroleum products
000189640	3121	HO57750	(—)	dibenzo(b,def)chrysene	AP	Occurs in combustion of coal tar and petroleum products
000106822	3121	RG15750	--	butyl-9,10-epoxy-stearate		Organic research
002426075	3121	RG94500	(—)	1,2:7,8-diepoxyoctane		Synthesized as a carcinogen in organ research
000141377	3121	RN77000	--	Epoxide 201[R]	AP	No longer used (replaced by a related compound)

Footnotes: see p. 38.

TABLE 3. (Continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000219421	3121	SF85250	(—)	phenanthro(1,2-d)thiazole		Organic research
000129000	3121	UR24500	(—)	pyrene		Biological research; organic synthesis
000253827	3121	VA12250	(—)	quinazoline		Synthesized from tricycloquinazoline for cancer research
000100538	3121	XT86500	(—)	alpha-toluenethiol		Occurs from petroleum refining
000138590	3112	GW46000	(—)	shikimic acid		Organic research
000842002	3112	WR10500	(—)	ENS; 4-(ethylsufonyl)-1-naphthalenesulfonamide		Organic research
023746341	3111	EY94500	(—)	bis(2-hydroxyethyl)-dithiocarbamic acid, potassium salt		Organic research
003693229	3111	HP45500	(—)	2-dibenzofuranamine		Occurs in combustion of coal tar and petroleum products
020566170	3111	WZ03500	(—)	4-(methylhydrazone)-N-isopropylterephthalaldehydamide		Organic research
000779475	3111	WZ05250	(—)	N-isopropyl terephthalamic acid		Organic research
002235598	3111	XS43750	(—)	N-isopropyl-alpha-(2-methylazo)-p-toluamide		Organic research
006120101	3111	ZE72500	(—)	4-dimethylamino-3,5-xylenol		Organic synthesis
000482495	2111	VS31500	(—)	doisynolic acid		Synthetic estrogen

Footnotes: see p. 38.

[a]New OTS rank in parentheses assigned from data contained in Suspected Carcinogens--A Subfile of the Registry of Toxic Effects of Chemical Substances (2nd Ed.), 1976. [When the route of administration is unknown, the highest exposure level (2) is assigned].

[b]Production Key (annual)

-- = known $<10^3$ lb; production figures available (IARC, EPA/OTS - 1977, or elsewhere)

(--) = assumed $<10^3$ lb; not listed in the Directory of Chemical Producers (DCP)

[c]IARC Review: Evaluation of carcinogenicity data on chemicals as reported by the International Agency for Research on Cancer (IARC) in their publication IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man (Vols. 1-13)

HP - Human Positive

HS - Human Suspected

AP - Animal Positive

AS - Animal Suspected

ID - Indefinite

(N) - Negative

[(C) - U.S. Occupational Standard-Carcinogen, as determined from NIOSH hazard review documents]

[d]Sources consulted for use information are listed in References.
Organic research: compounds synthesized as experimental carcinogens or as analogs to complete a structural series or class, analytical reagents, or laboratory curiosities.

[e]The name "urethane" is often applied to high molecular weight "polyurethanes" used as foams (insulation), elastomers, and coatings. However, these products are not made from the chemical urethane and do not generate it on decomposition.

[f]CAS No. as reported in the TSCA Candidate List of Chemical Substances (April 1977); it is identified also by a second CAS No.

[g]The CAS No. (001204791) reported in the RTECS Subfile (1976) is incorrect and is assigned to 4'-amino-(1,1'-biphenyl)-4-ol in the TSCA Candidate List.

[h]The CAS No. (004549444) reported in the RTECS Subfile (1976) is incorrect and is assigned to the n-butyl isomer (N-ethyl-N-nitroso-1-butylamine) in the TSCA Candidate List of Chemical Substances (April 1977). The present compound is not listed in the TSCA Candidate List.

[i]The CAS No. (005096195) reported in the RTECS Subfile (1976) is incorrect and is assigned to the (pyran-2-yl) form in the TSCA Candidate List. The present compound is not listed in the TSCA Candidate List.

[R]Registered trademark.

TABLE 4. CHEMICALS FROM THE NIOSH SUBFILE OF SUSPECTED CARCINOGENS (1975) WHICH WERE TESTED BY OTHER THAN ENVIRONMENTALLY SIGNIFICANT ROUTES OF ADMINISTRATION AND WERE FOUND TO PRODUCE TUMORS AT REMOTE SITES

A-1) Commercially Significant (annual production in excess of 1000 lb)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
007440473	4102	GB42000	IV ($> 10^7$ lb)	chromium	AS	Alloying and plating element on metal and plastic substrates for corrosion resistance; chromium-containing and stainless steels; nuclear and high-temperature research; constituent of inorganic pigments
001308389	4102	GB64750	IV	chromium (III) oxide	AS	Metallurgy; green paint pigments; ceramics catalyst in organic synthesis; green granules in asphalt roofing; component of refractory brick
000091203	4101	QJ05250	IV	naphthalene		Intermediate (phthalic anhydride, naphthol, chlorinated naphthalenes, solvents, dyes); moth repellent; fungicide; explosives; cutting fluid; lubricant; synthetic resins; synthetic tanning; wood preservative; solvent; textile chemicals
000079118	3101	AF85750	IV	chloroacetic acid		Herbicide; preservative; bacteriostat; intermediate in production of carboxymethylcellulose, ethyl chloroacetate, glycine, synthetic caffeine, sarcosine, thioglycolic acid, dyes, EDTA, 2,4-D, and 2,4,5-T
000092524	3101	DU80500	IV	biphenyl; diphenyl		Organic synthesis; heat-transfer agent; fungistat in packaging of citrus fruits; plant disease control; manufacture of benzidine; dyeing assistant for polyesters
000302012	3101 (3112)	MU71750	IV[e]	hydrazine	AP	Rocket propellant; oxygen scavenger in boiler water treatment; production of agricultural chemicals, pharmaceuticals, and blowing agents; solder fluxes; polymerization catalyst
000078002	3101	TP45500	IV	tetraethyl lead	ID	Antiknock additives for gasoline
001401554	4101	WW50750	III ($> 10^6$ lb)	tannic acid	AP	Textile mordant and fixative; writing and printing ink additive; deflocculating agent; tanning agent for leather; post-treatment of acid-dyed nylon; pharmaceuticals; chemical intermediate; food additive

Footnotes: see pp. 47 and 48.

TABLE 4. (SECTION A-1 continued)

CAS NO.	OTS RANK[a]	NIOSH SORI KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000149304	3101	DL64750	III	2-mercaptobenzothiazole; MBT		Vulcanization accelerator for rubber; fungicides; corrosion inhibitor in cutting fluids and petroleum products; additive in extreme pressure greases
000074317	3101	ST22750	III	N,N'-diphenyl-1,4-phenylenediamine; DPPD		Flex-resistant antioxidant in rubbers; stabilizer; polymerization inhibitor; copper degradation retarder; intermediate for dyes, drugs, plastics, and detergents
000373024	4101	QR61250	II (> 10^5 lb)	nickel acetate; nickel (II) acetate	ID[f]	Textile mordant; hydrogenation catalyst; (1968 consumption estimated at over 400,000 pounds)
014324551[g]	3101	ZH03500	II	zinc (bis)diethyldithio-carbamate; Ethyl Zimate[R]; ethyl ziram		Rubber vulcanization accelerator, especially latex foam; heat stabilizer for polyethylene; (927,000 pounds produced in 1975)
010108642	4204	EV01750	I (> 10^3 lb)	cadmium chloride; cadmium dichloride	AP	Production of pesticides, photographic chemicals, and phosphors; dyeing and calico-printing of textiles; electronic vacuum tubes; lubricant ingredient; manufacture of special mirrors
000050180	4204 (7325)	RP59500	I	cyclophosphamide	HS	Proposed as a defleecing agent for sheep (currently pending FDA approval); widely used antineoplastic and immunosuppressive agent
001066304	4101	AG29750	I	chromic acetate; chromium (III) acetate	ID	Textile mordant; tanning agent
000134327	3101	QM14000	I[g]	1-naphthylamine	HS(C)[h]	Dye intermediate; agricultural chemicals; manufacture of rubber antioxidants; (2-naphthylamine is a contaminant of commercial 1-naphthylamine)
000080115	3101	XT59500	I	N-methyl-N-nitroso-p-toluenesulfonamide; Diazald[R]		Reagent for the preparation of diazomethane
010141056	2101	GG11090	I	cobalt (II) nitrate; cobaltous nitrate		Sympathetic inks; cobalt pigments; catalysts; additives to soil and animal feeds; hair dyes; vitamin preparations; porcelain decoration (glazes)
007733020	2101	ZH52600	I[h]	zinc sulfate		Precipitating agent for viscose rayon; trace nutrient in animal feeds; fungicide; fertilizer ingredient; ore flotation; water purification; galvanizing

Footnotes: see pp. 47 and 48.

TABLE 4. (SECTION II-2 CONTINUED)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
003129917	4202	HY42000	(I)	dicyclohexylamine nitrite; dicyclohexylammonium nitrite		Corrosion inhibitor
001271289	4202	QR65000	(I)	dicyclopentadienyl nickel; nickelocene	AS	Catalyst; antiknock agent for fuels; complexing agent
000486259	4101	LL89250	(I)	9-fluorenone; fluoren-9-one		Organic research; (originally synthesized as an experimental insecticide)
007446277	4101	OG36750	(I)	lead (II) phosphate; lead orthophosphate; CI 77622	AP	Stabilizer in styrene and casein plastics
000086293	3101	AL98000	(I)	diphenylacetonitrile		Preparation of diphenylacetic acid; synthesis of antispasmodics; herbicides
000102772	3101	DL59500	(I)	2-(morpholinothio)-benzothiazole		Delayed action vulcanization accelerator
000155044	3101	DL70000	(I)	zinc 2-mercaptobenzothiazole		Rubber accelerator; fungicide
000092693	3101	DV58500	(I)	4-biphenylol;4-phenylphenol		Intermediate for dyes; resins; rubber chemicals; laboratory reagent; fungicide
000366187	3101	DW17500	(I)	2,2'-bipyridine		Reagent for iron determination
000592358	3101	EZ01750	(I)	n-butyl carbamate		Organic research; (listed in 1971 DCP, but not in 1975)
000105588	3101	FF98000	(I)	diethyl carbonate; ethyl carbonate		Solvent for nitrocellulose, cellulose ethers, and many synthetic and natural resins; organic synthesis
000102090	3101	FG05000	(I)	diphenyl carbonate; phenyl carbonate		Plasticizer and solvent; synthesis of polycarbonate resins
000120729	3101 (3122)	NL24500	(I)	indole		Chemical reagent; perfumery
000117806	3101	QL75250	(I)	dichlone; 2,3-dichloro-1, 4-naphthoquinone		Seed disinfectant; fungicide for foliage and textiles; insecticides; organic catalyst
000106149	3101	WI38500	(I)	12-hydroxystearic acid		Lithium greases; chemical intermediates
000141231	3101	WI42000	(I)	methyl 12-hydroxystearate		Adhesives; inks; cosmetics; greases

Footnotes: see pp. 47 and 48.

Minor Commercial Significance (annual production apparently below 1,000 lb)

CAS NO.	QTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
DYES, DYE INTERMEDIATES						
000129179	4102	IB91000	(—)	CI Acid Blue 3,sodium salt; CI 42045		Dye
002646175	3101	QL54250	—	1-(2-tolylazo)-2-naphthalenol; CI 12100	AP	Colorant for oils, varnishes, and waxes; (delisted by FDA for use in foods and drugs)
MISCELLANEOUS						
000540738	4303 (4314)	MV26250	—	1,2-dimethylhydrazine; SDMH	AP	Experimental rocket fuel; (no known commercial uses)
000062500	4204	PB21000	—	ethyl methanesulfonate; EMS	AP	Organic research; considered for use as reversible male chemosterilants for insects and mammalian pests and as possible human male contraceptive
000126852	4202 (4223)	IA22000	—	2,2'-dichloro-N-methyldiethylamine-N-oxide; nitrogen mustard amine oxide; NMO	ID	No commercial uses
000590965	4202	PC26250	—	methylazoxymethanol	AP[j]	Metabolite of cycasin (LZ59500)
001615801	4101 (4102)	MV22750	—	1,2-diethylhydrazine; SDEH	AP	Experimental rocket fuel; (no known commercial uses)
000505602	3102	WQ09000	(—)	bis(2-chloroethyl) sulfide; mustard gas	HS	Organic synthesis; tested as an antineoplastic agent; formerly used in chemical warfare
005431334	3101	RK07000	—	glycidyl oleate	ID[k]	Organic research; (no apparent commercial use

Footnotes: see pp. 47 and 48.

TABLE 4. (SECTION A-2)

A-2) Pesticides

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000123331	4202	UR59500	—	maleic hydrazide	ID	Systemic herbicide; treatment of tobacco plants; post-harvest sprouting inhibitor; weed control; sugar content stabilizer in beets
000122349	4202	XY52500	—	simazine		Herbicide for broadleaf and grassy weeds
000083794	4101	DJ28000	—	rotenone		Insecticide (toxic to fish); flea powders; fly sprays; mothproofing agents; (vet.) grubicide
000105362	3101	AF60000	—	ethyl bromoacetate		Pesticide
025168267[s]	3101	AG85750	—	isooctyl 2,4-dichlorophenoxy-acetate; 2,4-D isooctyl ester		Herbicide
000093765	3101	AJ84000	—	(2,4,5-trichloro-phenoxy)acetic acid; 2,4,5-T		Plant hormone; herbicide; defoliant
000075605	3101	CH75250	—	dimethylarsinic acid; cacodylic acid		Herbicide, especially for control of Johnson grass on cotton; soil sterilant; timber thinning; chemical warfare
015879933	3101	FH94500	—	alpha-chloralose		Bird repellent on seed grains; immobilizing agent to control depredating birds
039300453[s]	3101	GQ57750	—	dinocap		Acaricide (miticide); fungicide
014484641	3101	NO87500	—	ferric dimethyldithio-carbamate; ferbam	ID	Fungicide
000097165	3101	SK91000	—	2,4-dichlorophenyl benzenesulfonate; Genite[R]		Acaricide (miticide); insecticide
000087865	3101	SH63000	—	pentachlorophenol; PCP		Fungicide; bactericide; algicide; herbicide; sodium pentachlorophenate; wood preservative (telephone poles, pilings, etc.)
000133073	3101	TI56850	—	N-(trichloromethylthio)-phthalimide; folpet		Fungicide-bactericide for vinyls, paints and enamels; protective foliar fungicide on a wide variety of fruit and truck crops
000086884	3101	YT92750	—	alpha-naphthalenylthiourea		Rodenticide

Footnotes: see pp. 47 and 48.

TABLE 4. (SECTIONS B-1 AND B-2)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
		B-1)	Food-Cosmetic Related Chemicals			
007220817	4101	AW64750	--	aflatoxin B2	HS	Naturally occurring fungal byproduct in foods
000139059	3101	GV73500	--	sodium cyclamate		Nonnutritive sweetener; (use in foods prohibited by FDA)
		B-2)	Pharmaceuticals			
000050282	4304	KG29750	I	beta-estradiol	AP	Physiologically active isomer of estradiol (female sex hormone)
000053167	4304	KG85750	I	estrone	AP	Steroid hormone
000050760	4202	AU15750	--	actinomycin D; dactinomycin	AP	Antibiotic
002393535	4202	KG87500	--	benzoate estrone		Steroid hormone derivative
000052244	4202 (7313)	SZ29750	--	thiotepa; tris-(1-aziridinyl)-phosphine sulfide	AP	Antineoplastic agent
000130803	4202	WJ57750	--	diethylstilbestrol dipropionate		Synthetic nonsteroid compound with estrogenic activity
000302705	4101 (4121)	IA22750	--	nitrogen mustard N-oxide	AP	Antineoplastic agent
000303344	4101	OE78750	--	lasiocarpine	AP	Organic research; medicine; (isolated from plants)
000057681	4101	WO92750	--	Mermeth[R]		Antibacterial agent
000061336	4101	XH94000	--	penicillin G		Antibiotic
000069578	4101	XH98000	--	sodium penicillin G		Antibiotic; food and feed additive
000050500	3203	KG40500	--	estradiol benzoate		Estrogen derivative
000084162	3203	SL06000	--	hexestrol; dihydrodiethyl-stilbestrol		Nonsteroid synthetic estrogen
000113382	3202	KG47250	--	dipropionate estradiol		Estrogen derivative
000063058	3101	BV81500	--	4-androstene-3,17-dione		Androgen (male sex hormone)
000800248	3101	DK33250	--	aziridinyl benzoquinone	AP	Antineoplastic agent; organic research
000107697	3101	FD17500	--	2,2,2-trichloroethyl carbamate		Sedative; hypnotic
000604580	3101	KD71750	--	benzoate equilenin		Estrogenic activity
006030804	3101	KD78750	--	equilin-3-benzoate		Estrogenic activity

Footnotes: see pp. 47 and 48.

TABLE 4. (SECTION B-2 continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
000569573	3101	KV06000	—	chlorotrianisene		Synthetic nonsteroid estrogen
000299296	3101	LZ51500	—	ferrous gluconate		Treatment of anemia; food and feed additive; vitamin tablets
000056928	3101	HS15750	—	histamine dichloride		Medicine
000551746	3101	OP22750	—	mannomustine dihydrochloride; mannitol mustard dihydrochloride	AP	Antineoplastic agent
000494031	3101	QM24500	—	N,N-bis(2-chloroethyl)-2-naphthylamine	HP	Not used in U.S.
000057830	3101 (3102)	TW01750	—	progesterone	AS	Medicine; oral contraceptive; laboratory reagent
000446866	3101	UO89250	—	azathioprine		Immunosuppressive drug
000144821	3101	WP08750	—	sulfamethizole		Anti-infective drug
000058220	3101	XA30300	—	testosterone	AP	Male sex hormone; biochemical research
000066751	3101 (4202)	YQ89250	—	uracil mustard	AP	Antineoplastic agent
000057910	2101	KG37500	—	17-alpha-estradiol		Relatively inactive isomer of estradiol (female sex hormone)
000050271	2101	KG82250	—	estriol	ID	Naturally occurring estrogen

C) Little or No Information Available Concerning Commercial Importance

000613478	4203	NC42000	—	N-hydroxy-2-naphthylamine		Organic research
000589413	4202	FB17500	—	N-hydroxyurethan(e)[1]		Organic research
026630604	4101	DB26250	—	N-hydroxy-2-fluorenyl-benzenesulfonamide		Organic research
000821147	4101 (4122)	KH40250	—	azoethane		Organic research

Footnotes: see pp. 47 and 48.

TABLE 4 (SECTION C continued)

CAS NO.	OTS RANK[a]	NIOSH SORT KEY	ANNUAL PRODUCTION[b]	NAME	IARC REVIEW[c]	REPORTED USES[d]
016301261	4101	KH42000	—	azoxyethane		Organic research
000548936	3102	DG26250	—	2-amino-3-hydroxybenzoic acid		Organic research
000551939	3101	AM57750	—	2-aminoacetophenone; 2-acetylaniline		Organic research
004363035	3101	DV59500	—	4-amino-(1,1'-biphenyl)-3-ol		Organic research
004420795	3101	MX42000	—	hydroquinone mustard		Organic research
006810260	3101	NC31500	—	4-hydroxylaminobiphenyl		Organic research
006965715	3101	UF11500	—	2-(2,5-dichlorophenoxy)-propionic acid		Organic research
005684139	2102	VS30750	—	bisdehydrodoisynolic acid methyl ester		Organic research

Footnotes: see pp. 47 and 48.

[a]New OTS rank in parentheses assigned from data contained in Suspected Carcinogens - A Subfile of the Registry of Toxic Effects of Chemical Substances (2nd Ed.), 1976. [When the route of administration is unknown, the highest exposure level (2) is assigned.]

[b]Production Key (annual)

-- = known $<10^3$ lb; production figures available (IARC, EPA/OTS - 1977, or elsewhere)

(--) = assumed $<10^3$ lb; not listed in the Directory of Chemical Producers (DCP)

(I) = $>10^3$ lb; listed in DCP (no production figures available; however, inclusion in the DCP implies that a chemical has a production level greater than 1,000 pounds or total sales in excess of $1,000)

I = $>10^3$ lb; production figures available U.S. International Trade Commission (ITC), IARC, EPA/OTS - 1977, or elsewhere

II = $>10^5$ lb; production figures available ITC or elsewhere

III = $>10^6$ lb; production figures available ITC or elsewhere

IV = $>10^7$ lb; production figures available ITC or elsewhere

[c]IARC Review: Evaluation of carcinogenicity data on chemicals as reported by the International Agency for Research on Cancer (IARC) in their publication IARC Monographs on the Evaluation of the Carcinogenic Risk to Man (Vols. 1-13)

HS - Human Positive

HS - Human Suspected

AP - Animal Positive

AS - Animal Suspected

ID - Indefinite

(N) - Negative

[(C) - U.S. Occupational Standard-Carcinogen, as determined from NIOSH hazard review documents]

[d]Sources consulted for use information are listed in References.
Organic research: compounds synthesized as experimental carcinogens or as analogs to complete a structural series or class, analytical reagents, or laboratory curiosities.

[e]Combined production of anhydrous hydrazine and hydrazine hydrate estimated at 37 million pounds in 1974.

[f]No IARC Review was noted in the RTECS Subfile (1976); however, the IARC comments note that nickel in some form(s) is carcinogenic to man.

TABLE 4 (continued)

[g]Corrected CAS No.; listed number taken from the TSCA Candidate List of Chemical Substances (April 1977).

[h]Only one domestic producer reported in 1972; however, imports of 1-naphthylamine totaled 59,000 pounds in 1971. (Occupational exposure to commercial 1-naphthylamine containing 4%-10% 2-naphthylamine is strongly associated with bladder cancer. A number of case reports from several countries support this association. It is not possible on present evidence to decide whether 1-naphthalamine free from the 2-isomer is carcinogenic to man--IARC Monograph)

[i]Consumption of zinc sulfate totaled approximately 98,000 pounds in 1971.

[j]No IARC Review was noted in the RTECS Subfile (1976); however, the IARC Monograph indicates an AP Review.

[k]AS Review was noted in the RTECS Subfile (1976); however, the IARC Monograph indicates an ID Review.

[l]The name "urethane" is often applied to high molecular weight "polyurethane" used as foam (insulation), elastomers, and coatings. However, these products are not made from the chemical urethane and do not generate it on decomposition.

[R]Registered trademark.

APPENDIX

OTS RANK (FOUR-DIGIT) ASSIGNMENT

In ordering the initial NIOSH Subfile, a four-digit number (ABCD) was computed for each compound, utilizing data presented in the toxic dose lines for that compound. Only toxic dose lines that had a carcinogenic (CAR) or neoplastic (NEO) response noted were used. For this effort, CAR and NEO responses were considered equivalent.

The four-digit numbers were computed using the following criteria:

- The first digit, A, represents the species in which a CAR or NEO response is reported; assignments are:

  7: Humans

  6: Monkeys

  5: Cat, dog, pig, cattle, or domestic animal

  4: Rat

  3: Mouse

  2: Guinea pig, gerbil, hamster, rabbit, squirrel, or unspecified mammal

  1: Wild bird, bird, chicken, duck, pigeon, quail, or turkey

  0: Frog

  For compounds where CAR or NEO responses are reported in more than one species, the highest number is assigned.

- The second digit, B, designates the number of different species for which CAR or NEO responses are reported, to a maximum of 9.

- The third digit, C, designates the administration route for which a CAR or NEO response is reported:

  2: Inhalation, ocular, or skin application

  1: Oral administration

  0: All other routes of administration

  Only the highest number is used if CAR or NEO responses are reported for more than one route.

- The final digit, D, is the total number of CAR or NEO responses reported for this substance, to a maximum of 9. Because the NIOSH Subfile included only one toxic dose line for any route/species combination (specifically the study in which the lowest effective dose was reported for that combination), this digit is a count of the number of different route/species combinations reported to result in a carcinogenic or neoplastic response.

The following example illustrates the assignment of this number.

```
AB94500.  ACETAMIDE, N-FLUOREN-2-YL
          CAS: 000053963        MW: 223.29        MOLFM: N-O-C15-H13
          WLN: L B656 HHJ EMV1
          SYN: AAF  *  2-AAF  *  2-ACETAMIDOFLUORENE  *  2-
               ACETAMINOFLUORENE  *  2-ACETYLAMINO-FLUOREN
               (German)  *  N-ACETYL-2-AMINOFLUORENE  *  2-
               ACETYLAMINOFLUORENE  *  AZETYLAMINOFLUOREN
               (German)  *  FAA  *  2-FAA  *  N-2-
               FLUORENYLACETAMIDE  *  N-FLUOREN-2-YLACETAMIDE
        TXDS: orl-rat TDLo:475 mg/kg/11WC        TXAPA9 18,356,71
                TFX:CAR
              orl-rat TDLo:300 mg/kg/(9D preg)   TCIA** -,121,73
                TFX:TER
              skn-rat TDLo:260 mg/kg/71WI        JNCIAM 10,1201,50
                TFX:CAR
              ipr-rat TDLo:192 mg/kg/4WI         CNREA8 32,1554,72
                TFX:CAR
              imp-rat TDLo:22 mg/kg TFX:NEO      CNREA8 33,2489,73
              orl-mus LD50:1020 mg/kg            TXAPA9 25,447,73
              orl-mus TDLo:560 mg/kg/14DI        BJCAAI 19,297,67
                TFX:CAR
              par-mus TDLo:100 mg/kg/(12D preg)  ACATA5 37,239,66
                TFX:TER
              orl-dog TDLO:2625 mg/kg/25WC       CNREA8 10,266,50
                TFX:NEO
              orl-cat TDLo:4344 mg/kg/69WC       CNREA8 11,280,51
                TFX:CAR
              orl-rbt TDLo:4400 mg/kg/65WI       PAMIAD 32,177,68
                TFX:CAR
              ipr-rbt TDLo:3600 mg/kg/40WI       CNREA8 27,838,67
                TFX:NEO
              orl-ham TDLo:7980 mg/kg/38WC       GANNA2 59,239,68
                TFX:CAR
              itr-ham TDLo:15 gm/kg/74W          JNCIAM 50,503,73
                TFX:CAR
              orl-ckn TDLo:2888 mg/kg/13WI       BJCAAI 9,163,55
                TFX:CAR
         STANDARDS & REGULATIONS:
              USOS-carcinogen
```

The order number for this compound is 5729. The first digit (5) is assigned because a NEO response was reported in the dog; the second digit (7) is assigned because a CAR or NEO response was reported for seven different species (rat, mouse, dog, cat, rabbit, hamster, and chicken); the third digit (2) is assigned because a CAR response was

elicited with a skin application of the substance; and the last digit (9) is assigned because CAR or NEO responses were reported in 12 different route/species combinations (because the maximum allowable is 9, the last digit defaults to this).

RATIONALE

The following rationale was used to develop the individual digit assignment for the initial ordering exercise:

A. For the first digit, a CAR or NEO response reported in humans or primates indicates evidence or suspicion that the compound is a human carcinogen. Cats, dogs, etc., are ranked beneath humans on a phylogenic basis. While the rat and mouse are not phylogenically higher than the small mammals ranked beneath them, it is felt that, because these two species have been studied extensively and their physiological responses to chemical insult are far better understood, a CAR or NEO response is probably more meaningful than such a response in a less well studied species. Between these two species, the rat is given precedence because it is both better studied and longer lived than the mouse.

B. The rationale for the second digit is that a compound shown to be carcinogenic or neoplastic in two or more species is more likely to be universally carcinogenic than a compound for which the effect has been shown in only one species.

C. The third digit indicates the potential for carcinogenic or neoplastic response resulting from environmental exposure. In this respect, responses from inhalation or skin application are more indicative of concern for environmental exposure to the

substance than carcinogenic or neoplastic responses occurring from injection or implantation. Oral administration is considered intermediate.

D. The final digit indicates that the CAR or NEO response has been confirmed both in different species (as in the second digit) and by different routes of administration within a given species.

The arrangement of the four digits into the ABCD sequence is based on the relative significance of each. The first digit is considered most significant because it indicates the human carcinogenic potential of the compound. The second digit focuses on the universality of the response among different species and indicates the likelihood that the compound has human carcinogenic potential, but to a lesser degree than the first digit. The third digit reflects the next most significant parameter--the type of exposure required to elicit the response. The final digit indicates the degree of confidence about the carcinogenic or neoplastic response associated with the compound. Due to certain limitations involved in its genesis (for example, many known carcinogens are studied repeatedly to obtain tumors for further study), the fourth digit is given the least importance in ordering the compounds.

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CG 35000	1(A)20
CH 75250	4(A-2)43
CI 64750	1(A)9
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CO 17500	3--32
CQ 68250	2(B)26
CU 14000	3--36
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CV 92750	3--35
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CW 43750	3--30
CW 87500	3--30
CW 89250	3--31
CX 15750	3--29
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CY 03500	3--31
CY 10500	1(A)11
CY 14000	1(A)9
CY 28000	1(A)13
CZ 96250	1(A)14
DA 57750	1(B)21
DA 59500	2(A)25
DA 61250	1(A)18
DA 66500	1(B)21
DB 26250	4(C)45
DB 52500	1(B)21
DC 01750	1(B)21
DC 96250	1(A)12
DD 05250	1(A)10
DD 08750	1(A)13
DD 10500	1(A)15
DD 12250	1(B)13
DD 15750	1(A)15
DD 22750	1(B)21
DD 85750	3--32
DE 42000	2(A)25
DF 63000	3--36
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DG 12250	1(A)19
DG 26250	4(C)46
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DK 26250	1(A)16
DK 33250	4(B-2)44
DK 68250	1(A)18
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DL 42000	3--32
DL 59500	4(A-1)41
DL 64750	4(A-1)40
DL 70000	4(A-1)41
DM 19250	3--36
DM 85750	1(A)11
DP 63000	3--33
DS 14000	1(A)11
DS 28000	1(A)13
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DS 40250	1(A)13
DS 50000	1(A)13
DU 80500	4(A-1)39
DU 89250	1(A)17
DV 03500	3--33
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DV 33250	3--30
DV 40000	1(A)15
DV 49000	3--29
DV 56000	1(A)17
DV 58500	4(A-1)41
DV 59500	4(C)46
DV 87500	1(A)15
DW 17500	4(A-1)41
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EJ 82250	1(A)17
EJ 87500	1(A)20
EK 17500	2(B)26
EL 12250	3--33
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EO 54250	3--31
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FA 84000	1(A)13
FB 03500	3--30
FB 17500	4(C)45
FC 07000	1(B)21
FC 24500	1(A)14
FC 26250	3--36
FC 59500	1(B)21
FC 63000	3--29
FD 08750	1(A)12
FD 17500	4(B-2)44
FD 35000	1(B)22
FD 42000	1(A)20
FD 80500	1(B)22
FD 89250	1(B)21
FD 91000	1(B)22
FF 98000	4(A-1)41
FG 05000	4(A-1)41
FG 49000	1(A)9
FM 87500	2(B)26
FM 94500	4(A-2)43
FS 91000	1(A)10
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FZ 36750	1(A)19
GB 42000	4(A-1)39
GB 64700	4(A-1)39
GB 66500	1(A)14
GC 07000	3--36
GG 11090	4(A-1)40
GH 07000	2(B)26
GN 42000	2(B)26
GQ 57750	4(A-2)43
GS 60000	1(A)20
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GV 35000	1(B)22
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GV 71000	2(A)25
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HP 49000	3--33
HP 87500	3--33
HY 42000	4(A-1)41
IA 21000	2(B)26
IA 22000	4(A-1)42
IA 22750	4(B-2)44
IA 35000	1(A)19
IB 91000	4(A-1)42
IO 17500	1(B)21
IO 21000	1(B)21
IQ 05250	1(A)17
JG 82250	1(A)10
JJ 92750	1(A)16
JJ 95000	1(A)18
JJ 97000	3--33
JJ 98000	1(A)11
JO 12250	1(A)18
KD 71750	4(B-2)44
KD 78750	4(B-2)44
KG 29750	4(B-2)44
KG 37500	4(B-2)45
KG 40500	4(B-2)44
KG 47250	4(B-2)44
KG 82250	4(B-2)45
KG 85750	4(B-2)44
KG 87500	4(B-2)44
KH 40250	4(C)45
KH 42000	4(C)46
KH 57900	1(B)22
KH 78800	1(B)21
KI 07000	1(B)21
KJ 33250	1(B)22
KL 28000	1(A)14
KN 08750	1(A)12
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KU 96250	1(A)9
KV 06000	4(B-2)45
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KX 45500	1(A)10
KX 50750	1(A)10
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LL 69800	3--33
LL 89250	4(A-1)41
LL 91000	3--33
LQ 31500	3--29
LQ 92750	3--29
LT 77000	2(B)25
LU 35000	1(A)10
LV 17500	3--32
LZ 51500	4(B-2)45
LZ 59500	3--29
MA 10500	1(B)21
MA 12250	2(B)26
MF 22750	1(A)17
MF 42000	3--29
MS 15750	4(B-2)45
MU 10500	2(B)25
MU 17500	2(B)25
MU 71750	4(A-1)39
MV 22750	4(A-1)42
MV 24500	1(A)12
MV 26250	4(A-1)42
MV 28000	3--29
MV 29000	1(A)16
MV 56000	1(A)20
MV 80500	1(A)10
MV 96250	1(A)14
MX 35000	1(A)10
MX 42000	4(C)46
NC 31500	4(C)46
NC 42000	4(C)45
NC 47250	1(A)13
NI 50750	2(B)25
NI 56000	2(B)27
NI 96250	1(A)14
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NS 03500	2(B)27
NS 17500	2(B)25
NS 22750	2(B)27
OE 78750	4(B-2)44
OF 26250	1(A)11
OF 67300	1(A)17
OF 80500	1(A)16
OF 87500	1(A)14
OG 20250	1(A)10
OG 36750	4(A-1)41
OL 01750	3--34
OP 22750	4(B-2)45
OS 10500	1(B)21
OS 91000	1(A)20
OT 01750	1(A)20
PA 70000	3--30
PB 05250	3--34
PB 21000	4(A-1)42
PB 26250	3--30
PB 52500	1(A)15
PC 12250	1(B)22
PC 26250	4(A-1)42
PC 28000	3--31
PC 82250	1(A)18
QE 75250	3--29
QJ 05250	4(A-1)39
QJ 24500	3--34
QJ 36750	3--34
QJ 65300	1(A)12
QJ 65500	1(A)11
QJ 66500	1(A)19
QJ 68250	1(A)13
QK 27050	1(A)12
QL 01750	3--36
QL 49000	1(A)12
QL 54250	4(A-1)42
QL 59500	1(A)19
QL 71750	1(A)16
QL 75250	4(A-1)41
QM 14000	4(A-1)40
QM 21000	1(A)14
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QM 45500	1(A)11
QM 47250	1(A)19
QR 59500	1(A)9
QR 61250	4(A-1)40
QR 65000	4(A-1)41
RC 89250	2(B)25
RC 89600	2(B)27
RG 15750	3--36
RG 94500	3--36
RK 07000	4(A-1)42
RN 77000	3--36
RN 85750	2(B)26
RN 86400	1(A)17
RP 54250	1(A)17
RP 59500	4(A-1)40
RQ 73500	1(A)17
RS 82250	1(A-)16
SC 12250	3--32
SD 94500	1(A)12
SF 78750	1(A)19
SF 85250	3--37
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SG 01750	3--34
SJ 33250	1(A)9
SJ 77000	1(A)18
SJ 98000	2(B)22
SK 26250	1(A)16
SK 85750	1(A)16
SK 91000	4(A-2)43
SL 06000	4(B-2)44
SM 63000	4(A-2)43
SN 05250	2(B)27
SN 07000	1(A)20
SN 15750	1(B)22
ST 22750	4(A-1)40
ST 29000	1(A)19
ST 33800	1(A)12
SZ 17500	1(A)20
SZ 19250	1(A)13
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TH 75250	3--34
TI 56850	4(A-2)43
TL 63000	1(A)17
TN 21000	3--29
TP 45500	4(A-1)39
TQ 13600	1(A)17
TQ 13620	1(A)20
TQ 13720	1(A)20
TQ 13740	1(A)20
TQ 13760	1(A)17
TU 37500	2(B)25
TU 40750	2(B)25
TW 01750	4(B-2)45
TX 49000	1(A)10
UC 07000	1(A)16
UE 78750	1(A)16
UF 11500	4(C)46
UO 89250	4(B-2)45
UQ 05250	3--32
UR 24500	3--37
UR 59500	4(A-2)43
UT 22750	3--34
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UT 36750	3--32
UZ 98000	3--34
VA 12250	3--37
VB 54250	3--34
VB 57750	3--34
VB 59500	3--35
VB 61250	3--35
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VB 75250	3--35
VB 77000	3--35
VB 98000	3--30
VC 01750	3--30
VC 21000	1(A)18
VC 42000	1(A)17
VC 82250	3--35
VD 19800	3--35
VD 20000	3--35
VQ 31500	3--31
VQ 33250	3--32
VS 30750	4(C)46
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VT 29750	1(A)18
WG 98000	2(B)26
WH 66500	1(B)22
WI 38500	4(A-1)41
WI 42000	4(A-1)41
WJ 40250	3--35
WJ 56000	1(A)14
WJ 57750	4(B-2)44
WO 92750	4(B-2)44
WP 07000	2(B)23
WP 08750	4(B-2)45
WP 23600	2(B)23
WQ 09000	4(A-1)42
WR 10500	3--37
WS 77000	3--32
WS 78750	1(A)13
WS 82250	1(A)13
WT 29750	1(B)22
WW 50750	4(A-1)39
WZ 03500	3--37
WZ 05250	3--37
XA 30300	4(B-2)45
XH 94000	4(B-2)44
XH 98000	4(B-2)44
XJ 46000	3--31
XJ 49000	3--31
XJ 50750	3--31
XN 08000	3--35
XS 43750	3--37
XS 47250	2(B)23
XS 80500	1(B)21
XS 96250	1(A)9
XT 59500	4(A-1)40
XT 70000	1(A)15
XT 86500	3--37
XU 28000	1(A)16
XU 29750	1(A)16
XU 88000	1(A)12
XY 21000	3--31
XY 26250	1(A)16
XY 52500	4(A-2)43
XZ 14000	1(A)15
XZ 18000	1(A)15
XZ 21000	2(B)26
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YR 06000	2(B)25
YR 08750	2(B)26
YR 14000	2(B)26
YR 15750	2(B)27
YS 29750	2(B)26
YT 22750	2(A)25
YT 78750	1(A)13
YU 28000	1(A)11
ZE 56000	1(A)16
ZE 57750	1(A)16
ZE 61250	1(A)16
ZE 63000	1(A)16
ZE 64750	1(A)20
ZE 72500	3--37
ZH 01750	1(A)11
ZH 03500	4(A-1)40
ZH 05250	1(A)10
ZH 52600	4(A-1)40